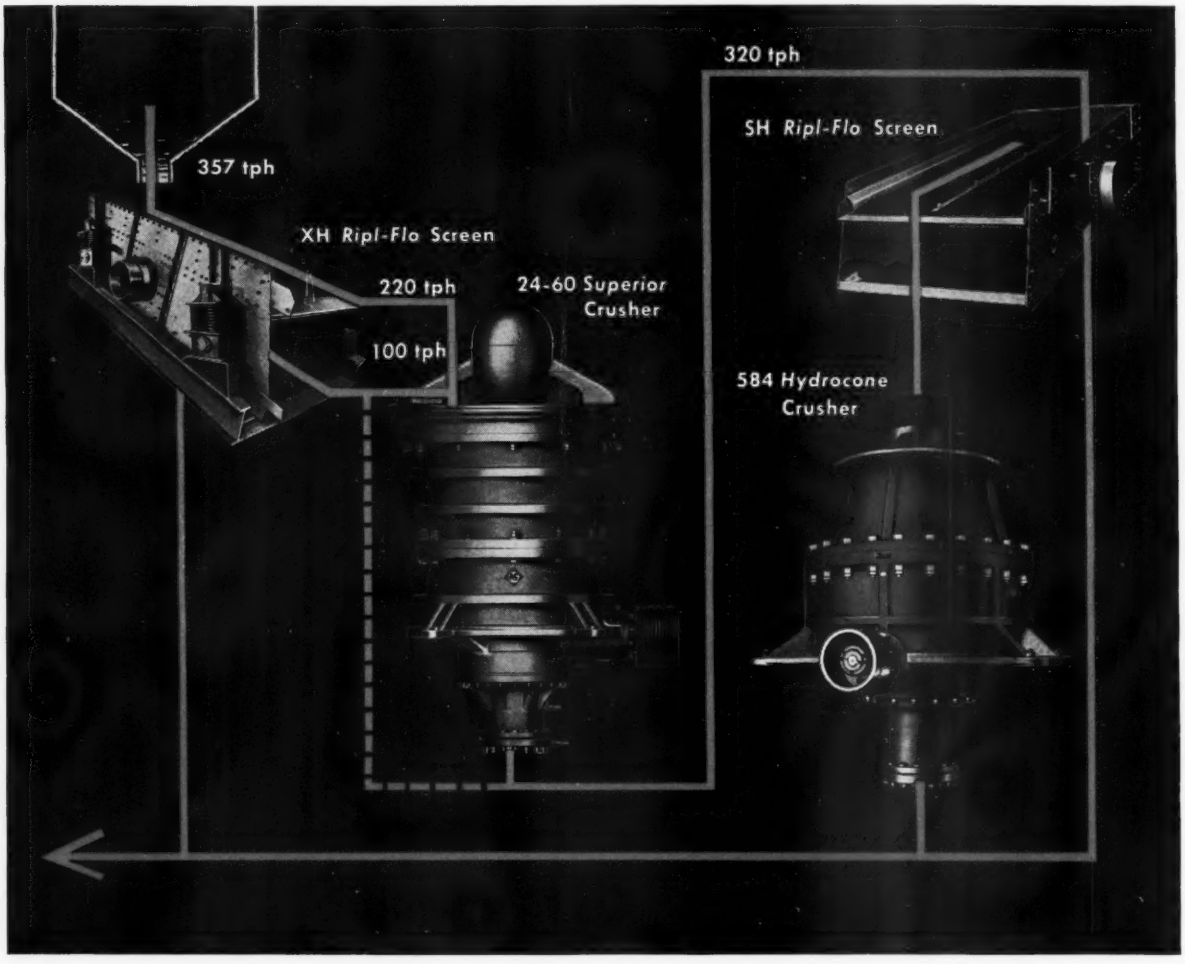
MINING JOURNAL

AMERICAN MINING CONGRESS

The Seattle Story

See page 58

ALLIS-CHALMERS



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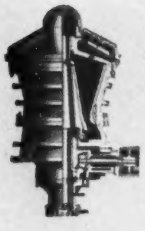
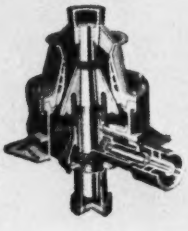


SUPERIOR gyratory crushers are built for rugged primary and secondary crushing loads. Capacities from 170 to 3500 tph. Twelve sizes.



HYDROCONE crushers, built to economize on secondary and tertiary stages, have capacities from 7 to 1050 tph. Twenty-one sizes.

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VOL. 47 OCTOBER 1961 NO. 10

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CONTENTS

Opinions expressed by the authors within these pages are their own and do not necessarily represent those of the American Mining Congress.

ARTICLES

Maintenance at Moss No. 3 Mine — 36
Ballard Taylor

Ground Water Control at Grace Mine — 39
G. K. Biemesderfer and R. H. Leske

Control of a Large Blast to Tonnage Requirements — 45
H. A. Corre

Profitable Control of Production and Transportation Through Operations Research — 47
David B. Hertz and Norman O. Olson

Application of X-Ray Emission to On-Line Control — 51
W. F. Loranger and R. G. Edholm

Sunnyhill No. 9 — 56
E. W. Pearson

Maintenance at the Operation — 80
John G. Warner

Improvements in Conveyor Belting in the United Kingdom—Part II — 83
S. Weinberg

Importance of Research in Creating Mineral Resources — 88
Thomas B. Nolan

SPECIAL SECTIONS

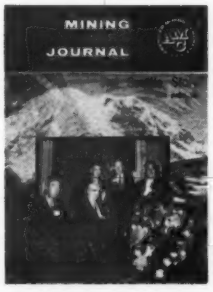
Declaration of Policy — 27
Seattle Convention Report — 58
Coal Conference Announcement — 103

DEPARTMENTS

Report Corner — 2
Wheels of Government — 94
Personals — 96
News and Views — 99
Manufacturers Forum — 111

ON OUR COVER

Scenes at the 1961 AMC Convention in Seattle. Background — Beautiful Mt. Rainier. Insert — (left) Speakers at the opening session included Charles E. Schwab, Kenneth C. Kellar, Assistant Secretary of Interior John M. Kelly, Congressman Walter Rogers, and AMC President Raymond E. Salvati. (right) Characterizing the sessions were audiences of alert mining men, intent on exchanging ideas and gaining information on the latest economic, legislative, and technical developments in the industry. See p. 58.



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Recent Publications of Interest to Mining Men

USBM IC 8003. "Possible Uses for Bacteria in Metallurgical Operations," by Joseph A. Sutton and John D. Corrick.*

USBM IC 8008. "Coal Research Organizations: Their Activities and Publications, by Mary S. Esfandiary.*

USBM IC 8016. "Mining Methods and Practices, Hurricane Creek Bauxite Mine, Reynolds Mining Corp., Saline County, Ark.," by Raymond G. Travis.*

USBM RI 5765. "Selective Flotation of Fine-grained Lead-Zinc Sulfides from Idaho and Washington" by A. E. J. Gallagher, W. A. Stickney, J. E. Shelton and F. W. Wessell.*

USBM IC 7986. "Mining Methods and Costs, Regal Asbestos Mine," Gila County, Ariz., by L. A. Stewart.*

***Available from Publications Distribution Section, Bureau of Mines, 4800 Forbes Ave., Pittsburgh 13, Pa.**

Report of Progress No. 24. "Refractory Clays of Indiana, by Jack L. Harrison." Publications Section, Geological Survey, Indiana University, Bloomington. 25 cents. Add 10 cents for handling orders under $1.00, 10 percent for orders over $1.00.

"Known Metallic Mineral Deposits in Arizona" (map), by Arizona Bureau of Mines. Director, Arizona Bureau of Mines, University of Arizona, Tucson. 50 cents.

Colorado State Bureau of Mines. "Annual Report for the Year 1960," by G. A. Franz, Jr. Bureau of Mines, 318 State Services Bldg., 1525 Sherman St., Denver 3, Colo.

Geological Survey Bulletin 1098-B. Geochemical Prospecting Abstracts (Jan. 1955–June 1957) by Ellen L. Markward. Superintendent of Documents, Government Printing Office, Washington 25, D. C. Price: 35 cents.

Chemical Processing of Fuels (Selected papers from 2nd All-Union Conference on Artificial Liquid Fuel and Gases — Moscow — 1957, translated from Russian). Office of Technical Services, Department of Commerce, Washington 25, D. C. Price: $1.25.

Paper 60-33. "A preliminary Study of Canadian Metallogenic Provinces" by A. H. Lang. Department of Mines and Technical Surveys, Ottawa, Canada. Price: 50 cents.

THIS MONTH

—MCJ Presents —and the

MAINTENANCE AT MOSS NO. 3 MINE

A mine that soon will be producing 6,000,000 tons of coal per year, Moss No. 3 must reduce down-time to a minimum. Preventive maintenance and "on-the-spot maintenance" combine to make this mine an outstanding operation. How to do it is explained in this "bread-and-butter article," beginning on page 36.

GROUND WATER CONTROL AT GRACE MINE

While diamond drilling the Grace mine ore body, the probable need for ground water control became evident. To circumvent the problem as far as possible, a dewatering program was begun in the shaft area and later extended to the ore body ahead of development. Dewatering was effected by pumping from deep wells as described in the article that begins on page 39.

CONTROL OF A LARGE BLAST TO TONNAGE REQUIREMENTS

To obtain effective results when shooting 30 to 40 tons of explosives in a single quarry shot requires careful planning. Warner Co. uses such blasts to break a year's supply of stone at the Union Furnace quarry as described in the article on page 45.

PROFITABLE CONTROL OF PRODUCTION AND TRANSPORTATION THROUGH OPERATIONS RESEARCH

Operations research is a statistical and mathematical approach to management problems that is replacing much "seat-of-the-pants" decision making. While it is no substitute for management judgment, it is becoming an increasingly valuable management tool. The article begins on page 47.

(Continued on page 5)

AUTHORS

Ballard Taylor, assistant superintendent of maintenance, Moss No. 3 mine, Clinchfield Coal Co., began his career in coal mining with South East Coal Co. in the mine shop. He has held various positions in maintenance and electrical work and prior to employment with Clinchfield he was chief electrician with Blue Diamond Coal Co., Leatherwood, Ky.

George K. Biemesderfer taught at Franklin and Marshall before joining Bethlehem Steel Co. in 1952 at Grace mine. He is currently exploration geologist for the company. Reinhold H. Leske come to Grace mine as mining engineer in 1957 from Reynolds Mining Co. He has served as shift foreman and engineer in charge of draw control and underground layout.

G. K. Biemesderfer

R. H. Leske

H. A. Corre has been with Warner Co. for 14 years. Early this year he was promoted from mine superintendent of the Bell mine to plant manager of the Bellefonte Division. Before joining Warner, he had been employed by the Mineral Industries Extension Department, Pennsylvania State University, and Consolidation Coal Co.

David B. Hertz is in charge of operations research for Arthur Anderson & Co. He was formerly associate professor of Industrial Engineering at Columbia University where he is a lecturer in operations research. Norman O.

D. B. Hertz

N. O. Olson

Olson, an accountant, has had extensive experience in operations research work. Both are partners in Arthur Anderson & Co.

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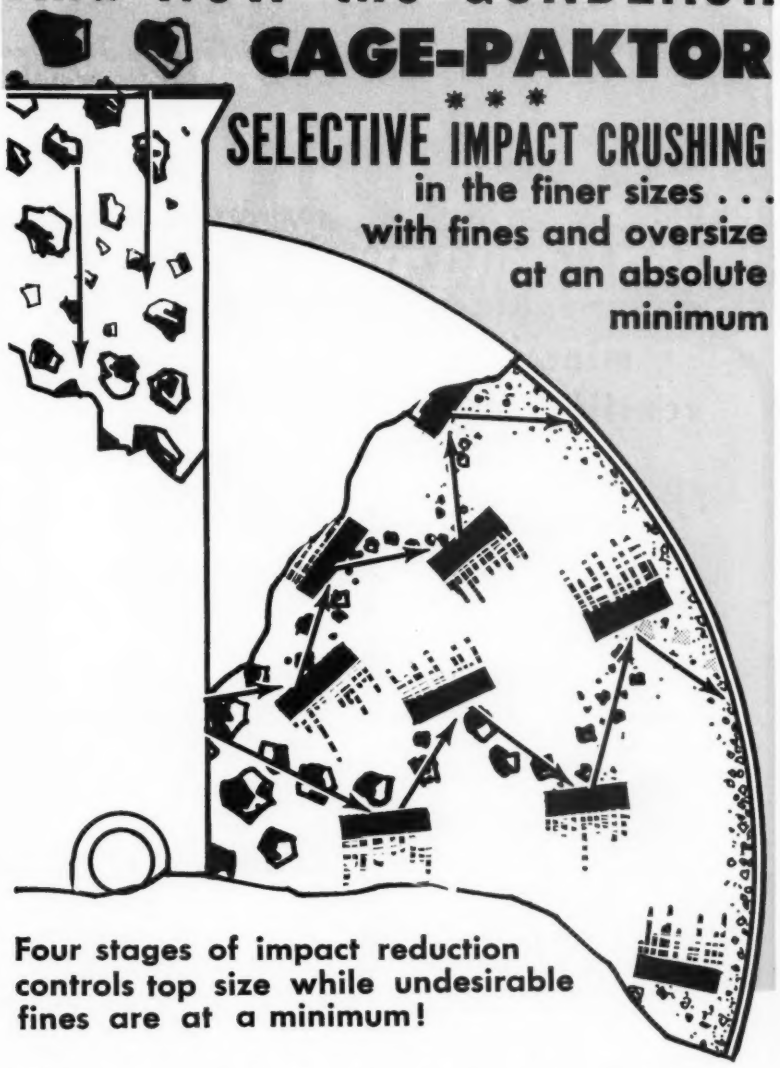

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This Month (continued) —*and the*

APPLICATION OF X-RAY EMISSION TO ON-LINE CONTROL

X-ray instrumentation that is capable of measuring six elements in a given material simultaneously is now being used for on-line chemical analysis. The material analyzed may be a liquid, slurry, or powder; the range of elements is generally from aluminum to uranium. See page 51.

SUNNYHILL NO. 9

A new strip mine with a projected capacity of 2,000,000 tons per year has been opened by Peabody Coal Co. A 46-in. seam is being mined with up to 130 ft of overburden. Stripping is accomplished with a 65-yd shovel, loading with a 7½-yd shovel and haulage by four 50-ton trucks. A modern preparation plant and other facilities combine to make the mine a leader in its field. See page 56.

MAINTENANCE AT THE MINE

A maintenance program can be more effective if it functions as part of the line organization and if performance is evaluated much as production is evaluated. Keeping good records is essential to a preventive maintenance and cost-cutting program since they provide the tools for planning and scheduling the work. Page 80.

IMPROVEMENTS IN CONVEYOR BELTING IN THE UNITED KINGDOM-PART II

A serious problem in United Kingdom coal mines—conveyor belt fires—has been solved by the National Coal Board. Part I of this two-part article described the problem in establishing standards for 5500 miles of conveyor belting. In Part II the author discusses the development of polyvinyl chloride non-flammable belting and the resulting cut in manufacturing and mining costs. Page 83.

IMPORTANCE OF RESEARCH IN CREATING MINERAL RESOURCES

Advances in science and technology create resources where none existed before. Three fields of research promise to create new mineral resources to meet future needs of the Nation—and each, if pursued aggressively, promises large economic returns. See page 88.

AUTHORS

William F. Loranger and Rolf G. Edholm are both with General Electric X-Ray in Milwaukee. Loranger has been a project scientist for the Air Force, taught at the U. S. Military

W. F. Loranger

R. G. Edholm

Academy and University of Florida and first joined G.E. in 1956. Edholm has wide teaching experience and was a research physicist with Continental Oil Co. when he joined GE seven years ago.

E. W. Pearson, mine superintendent with the Peabody Coal Co. at the Sunnyhill Mines, New Lexington, Ohio, began his career as pit foreman for Sinclair Mining Co. in 1948. He was pit foreman at the Homestead mine when Sinclair merged with Peabody. After several moves within the company, Pearson assumed his present position early in 1961.

John Warner's career has been devoted to operations, maintenance, and the design and construction of new facilities. For 14 years he was with Filtrol Corp., and later was chief engineer of a division of Macco Corp. With Minerals & Chemical Philipp Corp. since 1957, he is resident manager of its subsidiary, Chemstone Corp., Strasburg, Va.

S. Weinberg, a research and development specialist, joined the National Coal Board in 1955 as deputy chief engineer (technical) and since 1958 has been chief engineer (specialist services).

Thomas B. Nolan has been Director of the U. S. Geological Survey for five years. He obtained a Bachelor of Philosophy in metallurgy at Yale in 1921 and in 1924 was awarded a Doctorate in Geology from the same school. He then joined the USGS as a geologist, becoming assistant director in 1944.

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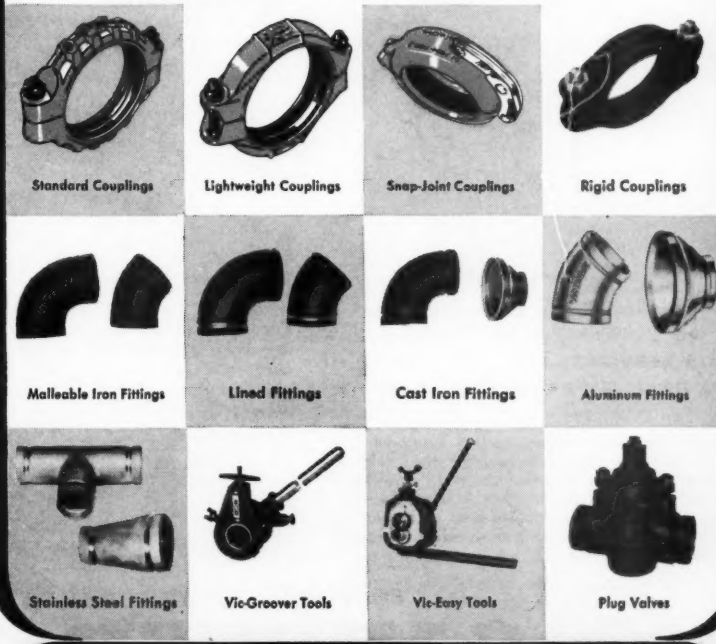

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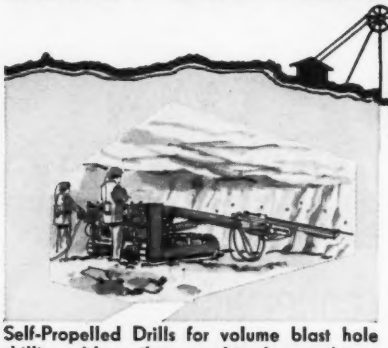
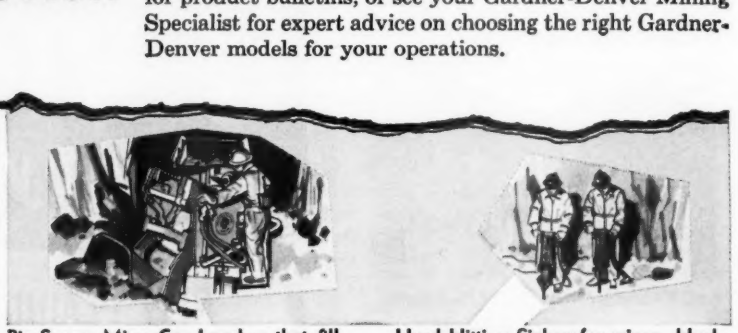


Self-Propelled Drills for volume blast hole drilling. Also rail-mounted jumbos, and jumbo components for building your own drilling machine. (Above)

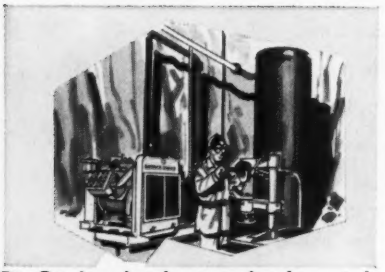


Big-Scoop Mine Car Loaders that fill long mine cars fast. (Above)

Hard-Hitting Sinkers for winze, blockholing, and shaft work. (Above)

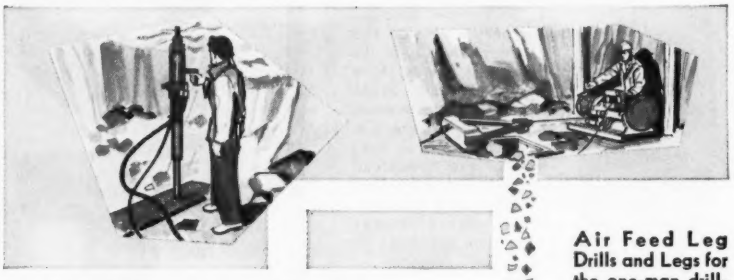
Powerful Stopers for fast, easy up-hole drilling in stopes or raises. (Below)

Double-Drum "Airslushers" speed ore transfer in the slusher drift. (Below)



Bit Grinders, bench- or pedestal-mounted, sharpen bits in the workings. (Above, right)

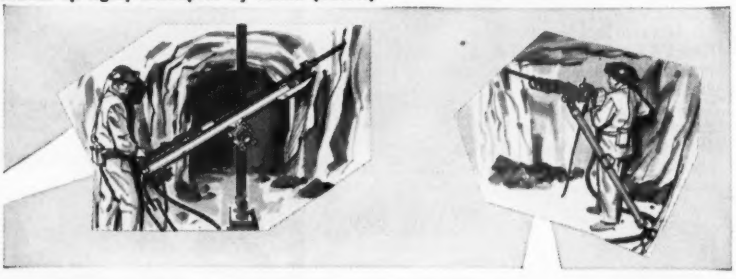
Air Compressors for underground or surface installations. (Above, left)



Long Hole Drilling with deep hole drifters, sectional rod and couplings, carbide insert bits. Gardner-Denver "HI-LEED"® steel makes up tight, uncouples by hand. (Below)

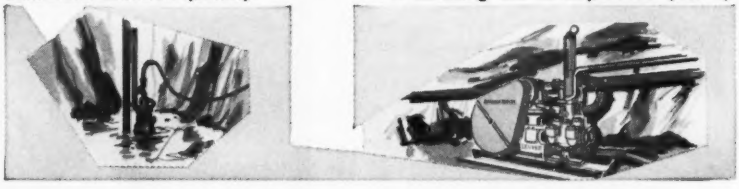
Air Feed Leg Drills and Legs for the one-man drilling crew. Line oilers for all rock drills and tools. (Below)

Complete Roof Pinning Machine. Drills the hole, inserts bolt, tightens nut. (Above)



Pneumatic Sump Pumps move water at low cost. Stainless steel models resist acid water corrosion. (Below)

Dewatering Pumps—steam-, air- or power-operated. High-pressure plunger pumps for surfacing ore in suspension. (Below)



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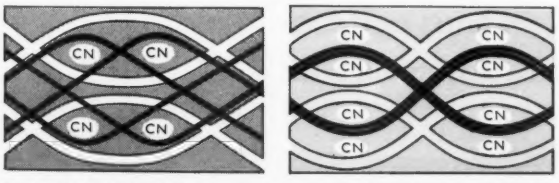
When all the facts are in, it's clear that no other interwoven belting can match U.S. Royal Gold Burro. This new belting has not only been made highly fire resistant without sacrificing strength, but its high-visibility gold cover insures maximum safety in dimly lit underground areas.



While inferior belts (left) have only one base layer to protect tension members after the PVC layer is worn through, the Royal Gold Burro (right) has an extra layer of cotton-nylon fillers to give added protection to the tension members—longer life to the belt. Note central placement of nylon tension members for maximum pulling strength.

And unlike other belting, whose strength members are covered by only one layer of base yarn, the yarn-dipped, all-PVC Royal Gold Burro has an extra layer of cotton-nylon fillers beneath its tough cover to give maximum protection to its extremely high-strength nylon tension members.

Extra strands of filament nylon on the belt's edges provide greater rip and tear resistance, add to Royal Gold Burro's excellent troughability and training characteristics.

Low-cost Royal Gold Burro Belting is available in standard widths and in lengths to 1,200 ft. For further information and on-the-spot assistance, call your nearest US Distributor.

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- LOWER — 32 INCHES HIGH
- FASTER — UP TO 80 FPM
- HEAVIER — 27 TONS
- CUTS THE DIAMOND PATTERN

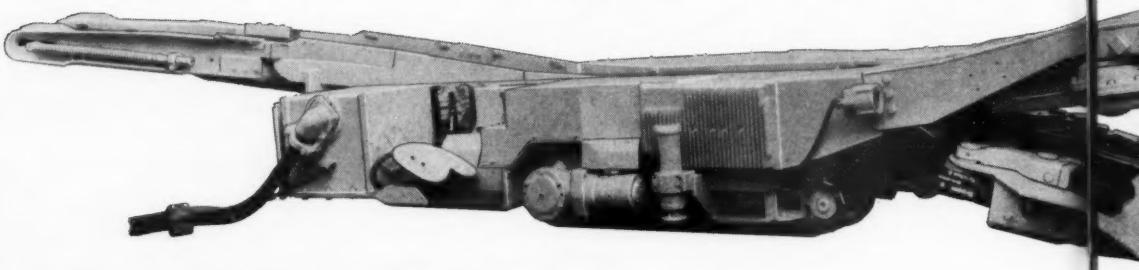
. . . the CM32 provides these benefits

The Lee-Norse CM32 MINER is designed to mine coal selectively from medium seams, ranging from 36″ to 68″ in thickness. Selective mining assures cleaner coal and reduced cleaning costs.

Low tramming and high cutting features increase coal production at extremely low operating costs.

Free-cutting action in a diamond pattern continuously gives uniformly coarser raw coal. The percentage of ¼ x 0 equals that for conventional mining, while per-

The CM32 is 32″ high, cuts coal from 36″ to 68″.



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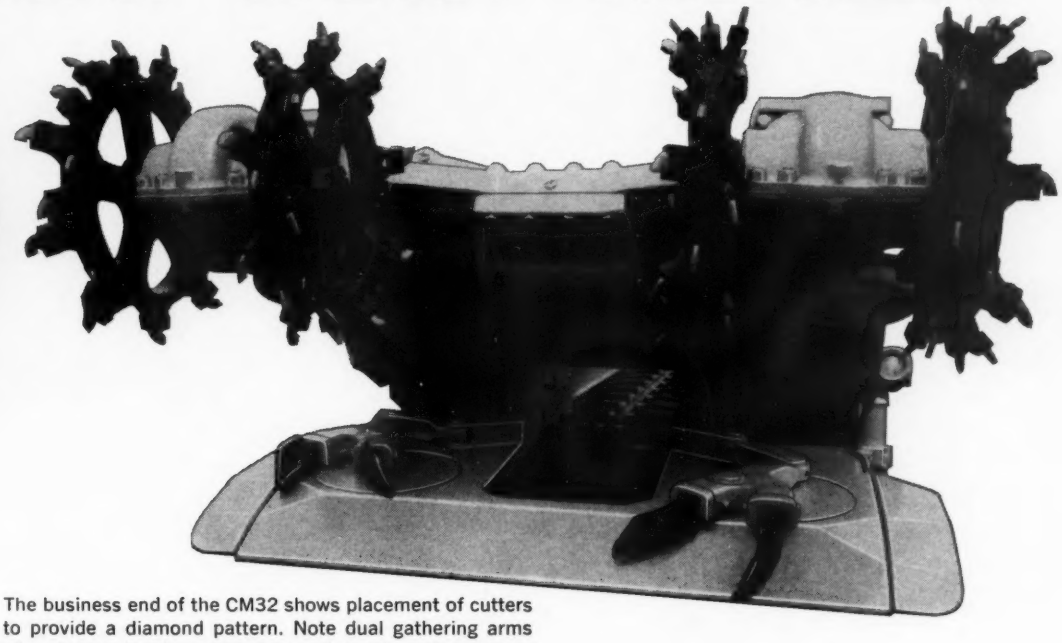
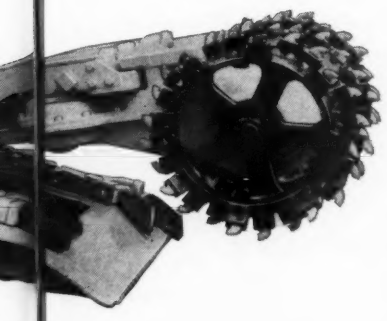


The business end of the CM32 shows placement of cutters to provide a diamond pattern. Note dual gathering arms of gathering head, and large throat opening of conveyor.

centage of ⅛ x 0 is generally about 2 per cent less. Ash content of ½ x 0 fraction has been proved to be less than that mined by other methods.

The use of parts proved and tested in larger machines assures less maintenance, fewer replacements; this means low maintenance cost and less downtime.

Coal production runs high, with profits at a new high level.



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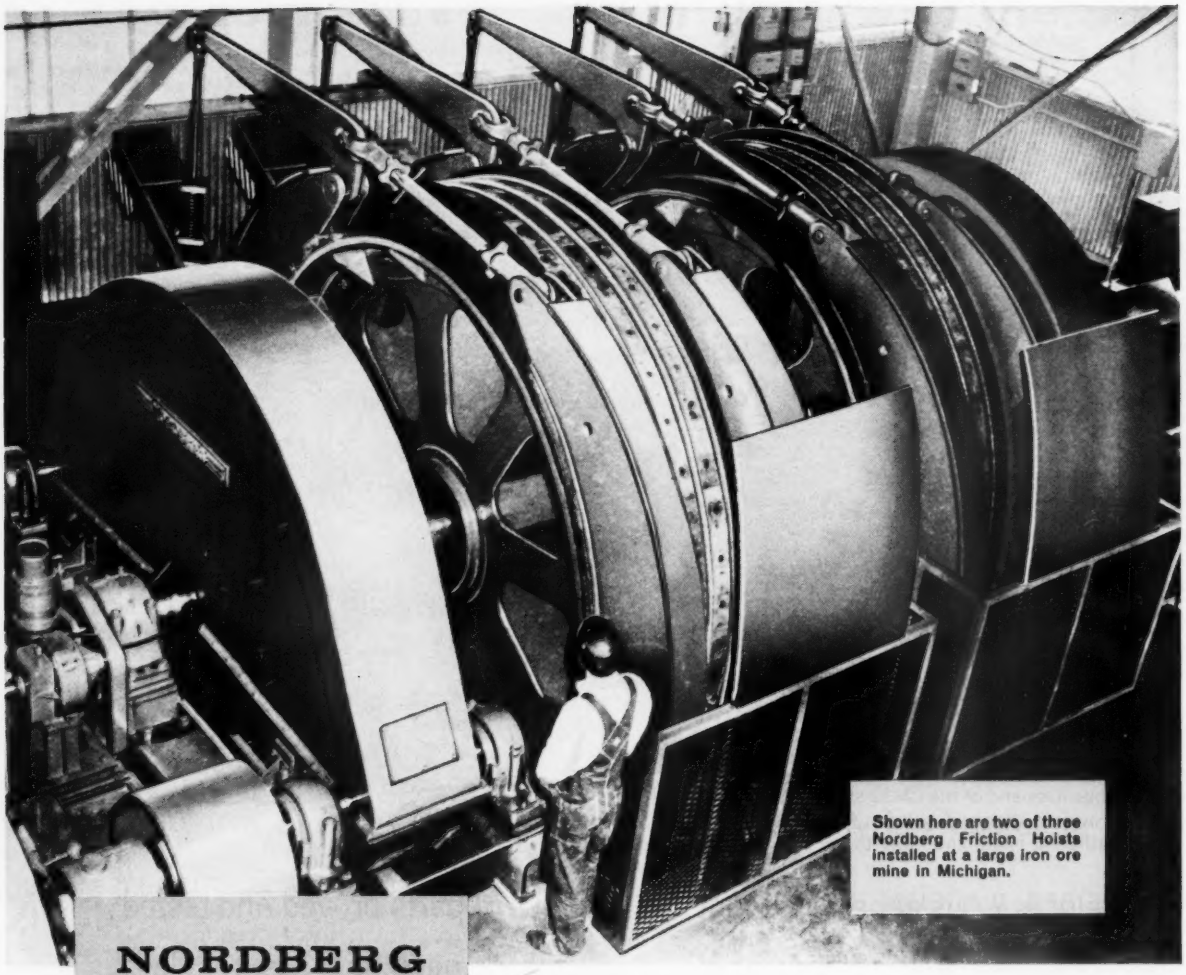

Shown here are two of three Nordberg Friction Hoists installed at a large iron ore mine in Michigan.

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Where applicable, service or production hoisting can be economically handled with Nordberg Friction Type Mine Hoists . . . built for either counterweighted or in-balance operation, geared or first motion electric drive, manual and/or fully automatic control.

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In addition to friction types, Nordberg *Drum Hoists* are in wide usage throughout the world; are available with manual, push-button semi-automatic, or fully automatic control.

It will pay you to let Nordberg's 65 years of specialized mine hoist experience help you select the right type and size hoist to best meet your specific needs.

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Our roof bolt engineers are specialists. By testing strata, they can recommend proper bolting procedures, and torque. They'll help to get your men started on the bolting. And they'll check back with you to test and inspect.

The assistance of our able engineers—and the use of dependable Bethlehem roof bolts—can increase both safety and efficiency in your haulageways and tunnels.

When you're ready . . . just tell us when and where.

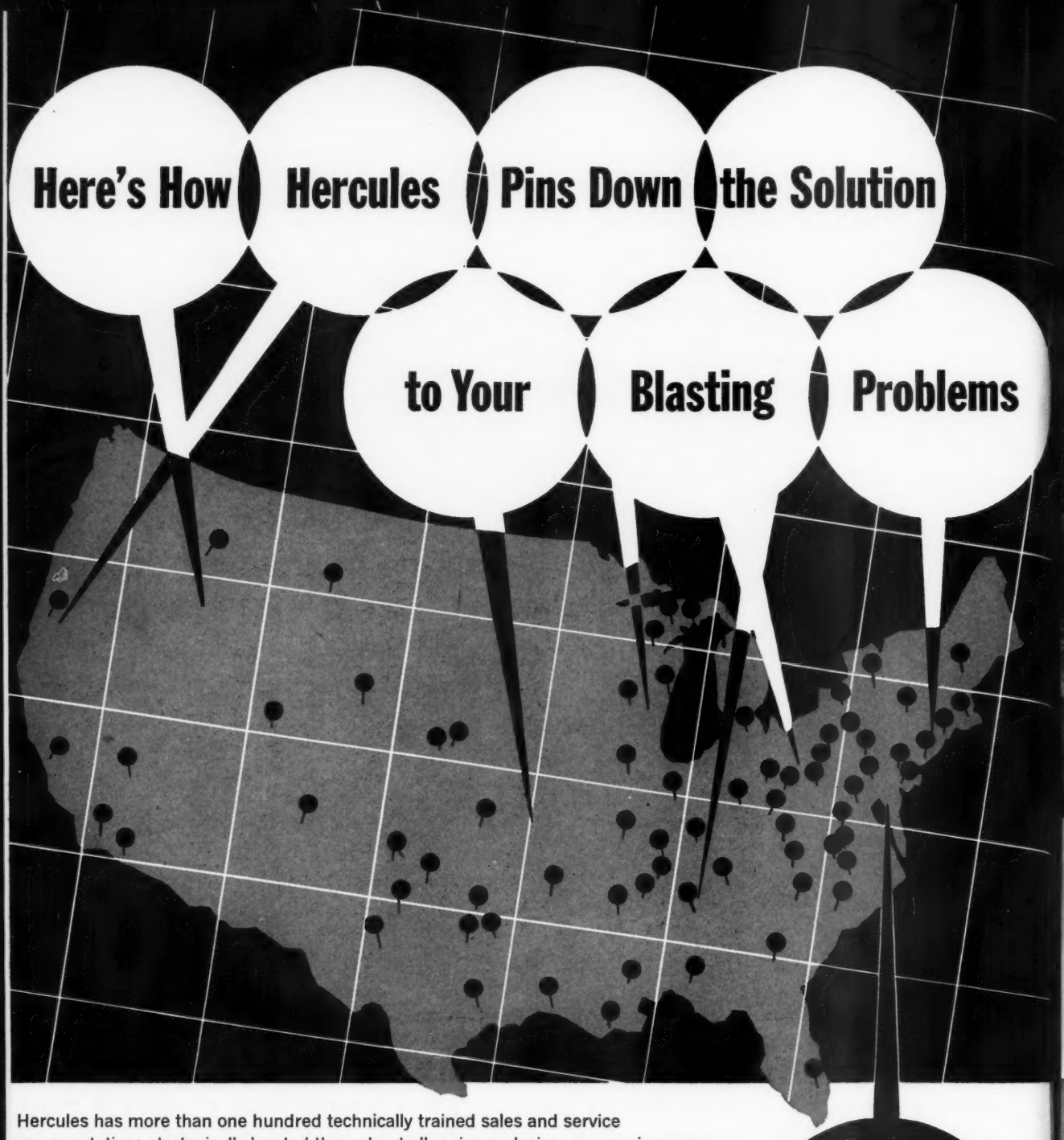
Steel

for Strength
. . . Economy
. . . Versatility

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL



Hercules has more than one hundred technically trained sales and service representatives strategically located throughout all major explosives-consuming areas. These Hercules men are ever ready to place their specialized talents at your service in helping to solve your blasting problems.

Whatever your blasting needs are, there is a Hercules® Explosive to do the work efficiently and economically. From specialized explosives for a specific use to the latest development in blasting agents, Hercules is able to meet your requirements quickly.

Explosives-manufacturing plants and distribution centers, adequately stocked with the major grades of explosives, are maintained in all mining and quarrying areas. Large quantities of standard grades and sizes, and a full line of blasting accessories are available for immediate delivery. Let our representative tell you how Hercules technical skill combined with Hercules Explosives can save you money.

XR61-2

HERCULES POWDER COMPANY

INCORPORATED

Explosives Department, Hercules Tower, 910 Market Street, Wilmington 99, Delaware

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O-B Designs for Mining Men

RESULT:

A circuit interrupter that costs less than any other type of cable protection... except the fuse!

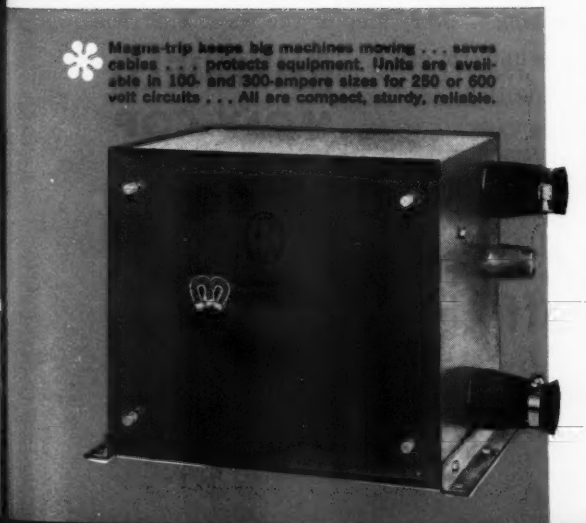
MAGNA-TRIP SNUFFS OUT SHORTS BEFORE THEY HAVE A CHANCE TO CAUSE TROUBLE. Ingenious design by O-B engineers results in a simple sturdy unit to protect machines, cables, and men. This safe control-device drastically reduces the danger and expense of cable fires.

VITAL MINING MACHINES PRODUCE MORE WHEN THEY'RE PROTECTED WITH MAGNA-TRIP. This efficient unit reduces damage resulting from shorts and faults in cables. Less damage means less lost labor . . . less lost time . . . less lost production on your jobs.

WHEN IT TRIPS . . . THERE'S TROUBLE. Magna-trip has been designed to allow for normal surge loads without "false tripping." When Magna-trip kicks out . . . there's trouble on your circuit . . . and you've saved damage and delay!

PAYS FOR ITSELF WITH THE FIRST CABLE IT SAVES . . . ALL OTHERS ARE PROFIT. Magna-trips cost less than the ordinary length of cable that it protects. The **first** time that it saves a cable that would otherwise have been destroyed . . . you've paid for your circuit interrupter. In its lifetime, your Magna-trip will return to you its cost many times over.

OHIO BRASS COMPANY, MANSFIELD, OHIO, Canadian Ohio Brass Company Ltd., Niagara Falls, Ontario.


Magna-trip keeps big machines moving . . . saves cables . . . protects equipment. Units are available in 100- and 300-ampere sizes for 250 or 600 volt circuits . . . All are compact, sturdy, reliable.

Ohio Brass

HOLAN

EXPANSION SHELLS AND PLUGS · LINE MATERIALS · SAFETY AND CONTROL EQUIPMENT · ELECTRIC HAULAGE MATERIALS

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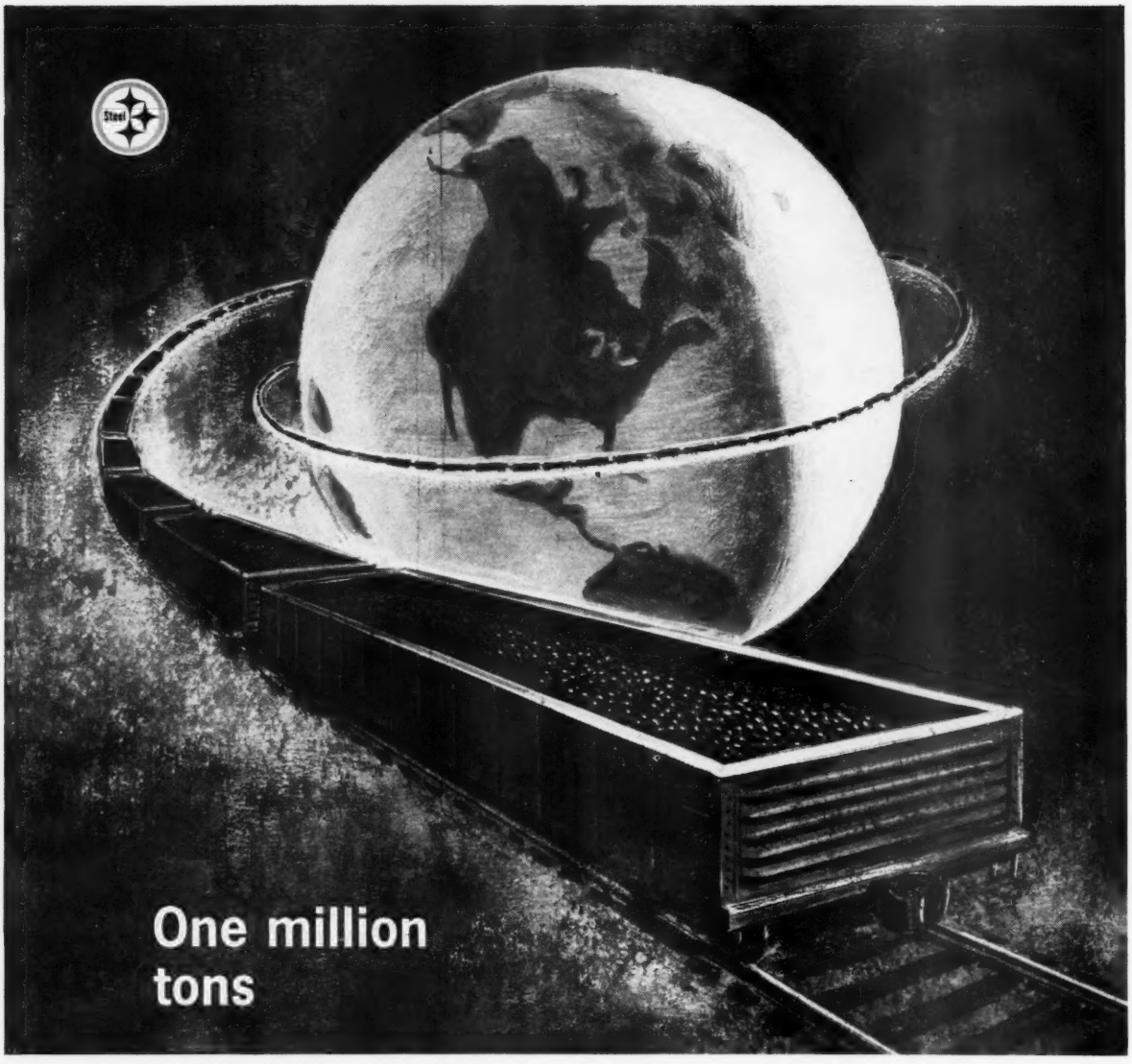


have earned customer acceptance

More than a million tons of Sheffield Grinding Balls of all kinds have proved their worth, throughout the world. This record of performance is no accident. It's the result of tight, quality control of alloying, heat-treating and forging — every step of the way. Sheffield Moly-Cop Balls keep their sphericity longer, give a better, more uniform grind, at the lowest possible cost per ton. No wonder Sheffield Grinding Balls are the standard of comparison, around the world. **Sheffield Division, Armco Steel Corporation, Sheffield Station, Kansas City 25, Mo.**

SHEFFIELD
MOLY-COP
Grinding Balls

ARMCO Sheffield Division

THE WHEAT SYSTEM

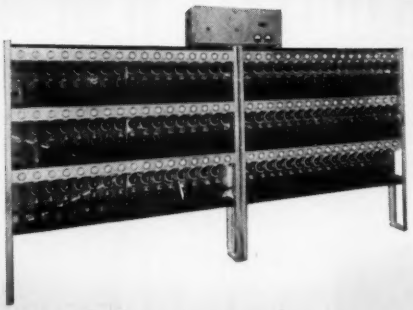
OF CONTINUOUSLY-IMPROVED COMPONENTS

CAP LAMPS

30% more light . . . finger-tip focussing . . . a perfect spot, every time

CHARGING EQUIPMENT

Fully automatic . . . electronically controlled . . . transistorized . . . true self-service



SERVICE

Competent . . . experienced . . . conveniently located in the major coal mining areas

—always

your best choice in better light for the miner

Yes, *whenever* you join The Trend to WHEAT, you enjoy the highest present development in better light for your men underground. And year after year, you benefit by steady, consistent, persistent improvement in every component of the Wheat System. You have *always* a cap lamp system modern as today—promptly equipped with the developments of tomorrow! *Talk over these facts with your National Mine man, in detail—now.*

National Mine Service Company

Koppers Building Pittsburgh 19, Pa.

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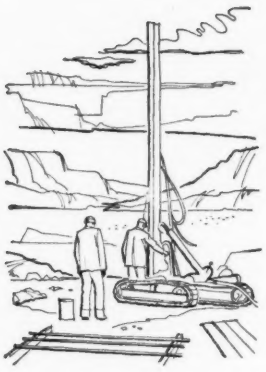

V-R PERCUSSION BITS...

hold gauge longer for clean, round blast holes!

The superior quality of V-R Percussion Bits goes to work for you where it counts — down in the hole. Carbide inserts, especially developed by V-R for tough drilling operations, give fast penetration and long life. A special fatigue-resistant steel alloy brings greatest possible strength to the bit bodies. Precisely controlled quality assures you of the same top performance from every V-R Percussion Bit you use. Complete line includes all popular thread types and other connections in bit diameters from 1⅜″ to 9″. Call your helpful V-R man today or write for free catalog VR-500.

VASCOLOY-RAMET CORPORATION, 850 Market Street, Waukegan, Illinois

M-855

FOR FAST, FLEXIBLE ROOF BOLTING

- BOLT UP A WHOLE FACE WITHOUT MOVING OR SHIFTING SAFETY JACKS!
- ANGLE-BOLT ANYWHERE AND USE EITHER ARC OR STRAIGHT LINE PATTERNS!
- CLIMB THE STEEPEST GRADES IN MUD OR RUTTED BOTTOM!
- USE MORE THRUST WITH LONGER FEED FOR FAST LOW-BIT-COST BOLTING!
- FORGET HIGH MAINTENANCE WITH THE RUGGED, SIMPLE FLETCHER DM ROOF DRILL

TAKE A LOOK at the NEW FLETCHER MODEL DM ROOF CONTROL DRILL

BUILT on a four-wheel chassis — with duals on the front — the new Fletcher DM Roof Drill has tractive power to spare. Power steer and individual motors on each wheel, shuttle-car wheel gauge and dual speed "creep-gear" drive let this drill move smoothly around the section regardless of bottom conditions.

The new swinging, sliding boom with 9 feet of in-out range cuts bolt installation time to the bone. A special tray on the boom carrying bolts and drill steels lets your operator complete the bolting of a full place without returning to his tram controls.

Add to this the new "hoseless" M-style mast that gives you up to 40% more feed and greater usable thrust; the new power-geared internal collection drill head; the husky rough service frame *and you can see why* the Fletcher Model DM ROOF DRILL is the newest, fastest, most dependable drill on the market today.

Inquire about it or see it in action in a a nearby mine. You'll want DM's in your mine if you do.

Fletcher
ROOF CONTROL DRILLS

J. H. FLETCHER & CO. | P. O. Box 2143, HUNTINGTON 18, WEST VIRGINIA
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Long-Airdox face preparation team sets fast pace for high-capacity mining systems

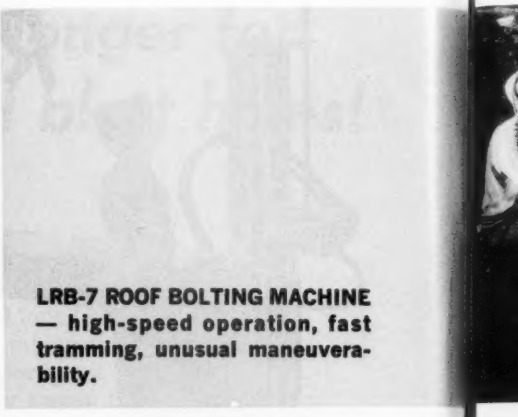
Here is how to have faster face preparation and higher production with lower costs—regardless of seam height. Take advantage of the superior speed and flexibility of this unique Long-Airdox face preparation team . . .

LRB-7 ROOF BOLTER. The most versatile and powerful machine of its type. Offers highest torque and thrust; most effective internal, through-steel dust collector; fast easy operation; low-maintenance hydraulic system.

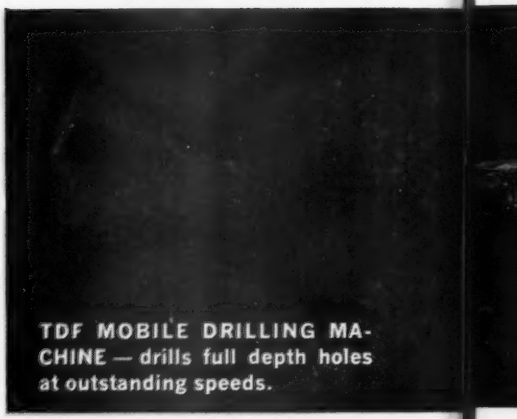
TDF DRILLING-SHOOTING MACHINE. Makes it possible for one man to handle both drilling and shooting in comparable time with either cutting or loading. "Rotary-Thrust" drilling principle applies thrust closer to face than any competitive machine. Three models for all seam heights and conditions.

AUTOMATIC AIRDOX SHOOTING. Faster than any other system and gives better product. Lighter weight automatic discharge tubes; sequence shooting of any number of holes in a single operation; and single-unit TDF drilling, multiple-shooting machine (which transports tubes and sequence valves) now make this system practical and economical for all conventional mining.

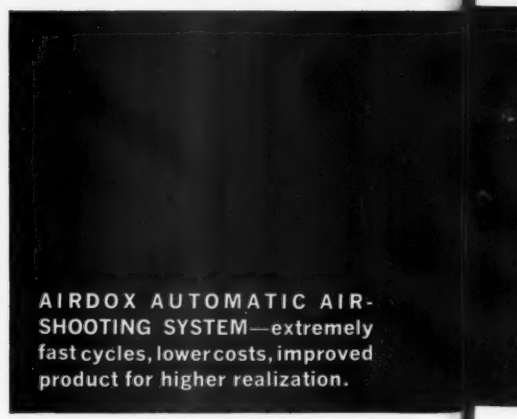
For facts and figures, write Long-Airdox, Oak Hill, West Virginia.



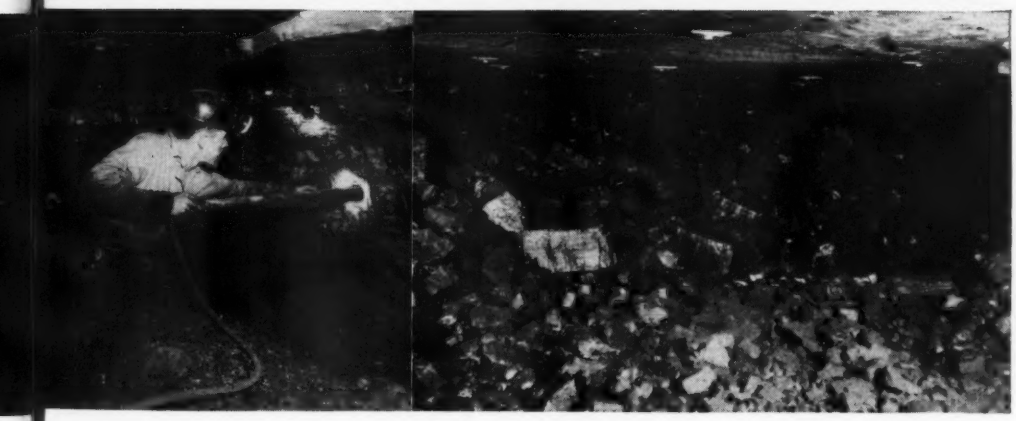
LRB-7 ROOF BOLTING MACHINE — high-speed operation, fast tramming, unusual maneuverability.



TDF MOBILE DRILLING MACHINE — drills full depth holes at outstanding speeds.



AIRDOX AUTOMATIC AIR-SHOOTING SYSTEM—extremely fast cycles, lower costs, improved product for higher realization.



LONG-AIRDOX

Profit Producers . . .

in

MINES and MILLS

prefer

HEAVY DUTY HYDRASTROKE* FEEDERS

. . . Reciprocating Feeders for High-Tonnage Loading of Belts, Trucks, Skips, Railroad Cars, Screens and Crushers

PATENT APPLIED FOR

Exclusive HYDRAULIC OPERATION

. . . designed for low installation, operation and maintenance costs. Fixed or variable feeding rates are easily available. Length of stroke can be varied from 6 to 24 inches.

MINIMUM HEAD ROOM . . . requirements are as little as 20 inches and construction costs reduced. Impact damage to unit being loaded is minimized . . . discharge drop only 6 to 8 inches.

ROCKER MOUNTING OR SUSPENSION . . . Both suspended or self-contained types eliminate costly wear due to friction which is present in other types of feeders. No lubrication needed . . . Durability characterized by its special rugged construction.

WIDE RANGE OF SIZES . . . Widths from 36 inches to 96 inches . . . feeding capacities from 200 to 7500 tons per hour.

Write for Illustrated Brochure

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Subsidiary of Pettibone Mulliken Corporation, Chicago 51, Illinois

NOMINAL HOLE SIZE—1⅞" TO 5⅝" ● DOWN PRESSURE—10,000 LBS. ● ROTARY SPEED TO 540 RPM

Here's the ultimate in a mobile drilling rig for holes to 5⅝" ...the all-new 350 REICHdrill.

Job performance records under extreme drilling conditions have proved the cost-cutting advantages of its all-hydraulic features: Rotary Top-Drive; Precise Feed Pressure Control; Fast-acting Levelling Jacks.

The 350 moves in quickly...sets-up fast, breaks footage records on every shift. Handles 3-cone rotary bits, in-hole drills, diamond core bits, wire line tools, or drag bits.

C-350 Crawler-Mounted REICHdrill is unmatched for maneuverability and stability. Trams easily at almost 8 mph ...can climb a 25% grade...turn in its own length. Low center of gravity...wide tracks help it meet and beat any tough terrain.

T-350 W Truck-Mounted REICHdrill has all the time-saving, cost-cutting hydraulic features of the crawler-mounted unit. Offers complete mobility...saves schedule-killing time on moves between drilling sites.

Ask for SP-5001-2

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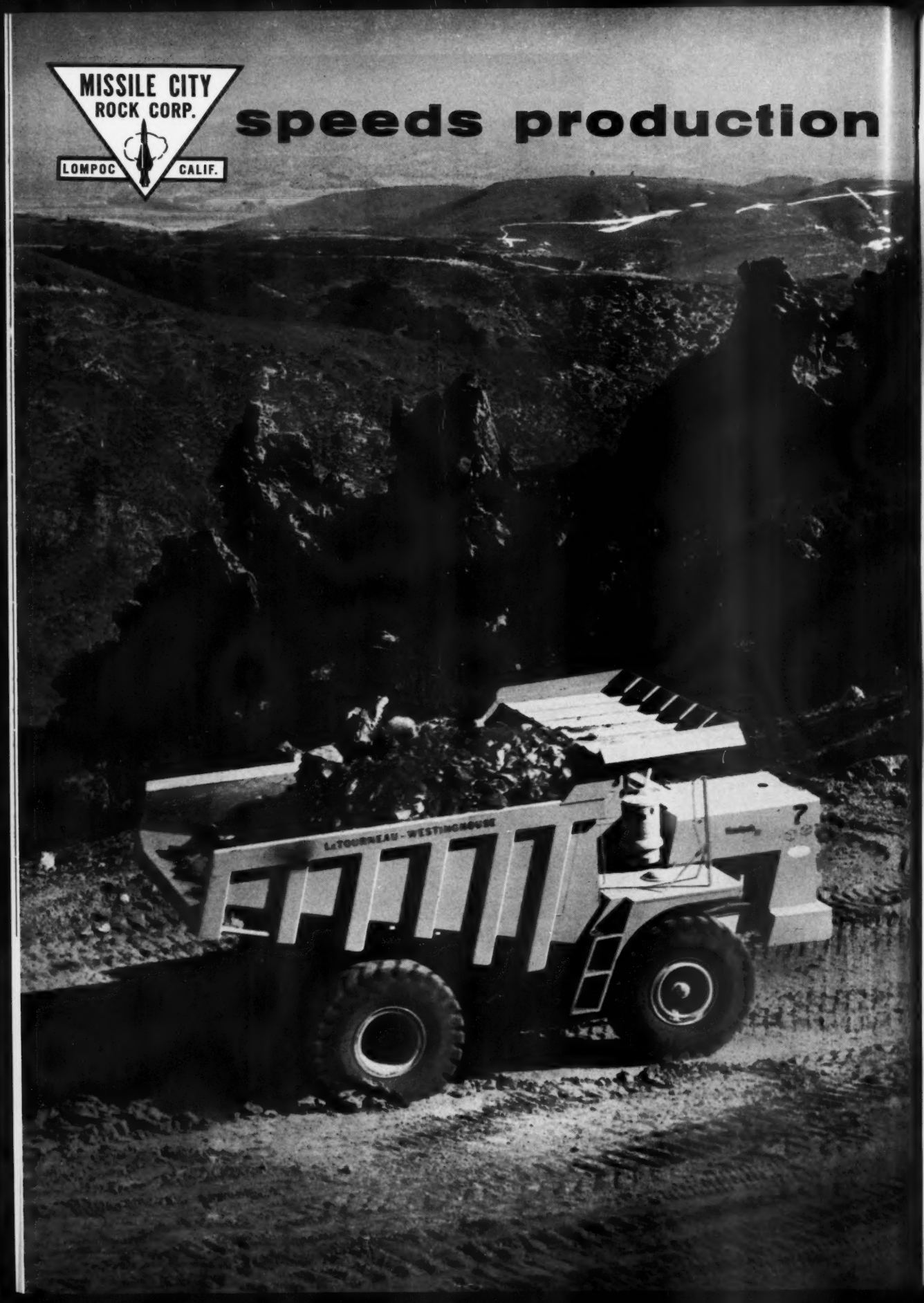

MISSILE CITY
ROCK CORP.
LOMPOC
CALIF.
speeds production
LeTOURNEAU - WESTINGHOUSE

with Haulpak® trucks

Almost overnight, Lompoc, California, once known mainly as "the flower-seed capital", has become a focal center of the Pacific Missile Range. At such nearby installations as Los Alamos, Vandenberg Air Force Base, and the Navy's Point Arguello, launching pads, roads, and other facilities are being built at a record pace. Much of the high-grade aggregate for these projects is supplied by Missile City Rock Corporation from its big, new, crushed-stone plant.

To keep raw materials flowing to the crusher at a steady rate, the firm works 3 LeTourneau-Westinghouse 32-ton Haulpak trucks. Here's a pictorial report of these 380-hp haulers at work.

We will give you complete information on LW Haulpak trucks. 5 end-dumps, 22 to 65 tons, up to 600 hp. 90-ton bottom dump also available.

Operators highball the 32-ton Haulpaks down narrow winding road. High, off-set cab with non-glare, canted windshield gives operator good visibility. Other safety factors that give him confidence to work at fastest practical speeds: low center of gravity . . . LW power steering . . . and air-craft type multi-disc air brakes (5,148 square inches of braking surface).

3,000 tons of overburden and rock is the average 8-hr-shift production for Missile City's 3 LW Haulpaks. Haul measures 2,500 feet, most of it down steep, winding 10% grade. Exclusive Hydrair® suspension keeps load riding level, cushions load and road shocks, gives longer tire life. In addition, this LW air-hydraulic suspension system eliminates springs, front axles, and related maintenance.

Short 44'6" turn radius of the 32-ton LeTourneau-Westinghouse Haulpak permits fast positioning under dipper. And look at the extra load capacity you get within short 10'10" wheelbase. Deep V-body carries up to 8 tons of material *below* normal floor line . . . giving Haulpak low center of gravity, exceptional stability — on turns and slope work.

One of Missile City Rock Corporation's Haulpaks dumps rocky overburden at waste bank. Note that the twin 3-stage hoists are inverted to shed abrasive dust and dirt. Straight, smooth body floor, with no "kick up" at back, speeds ejection. Exhaust-heated body prevents material from sticking.

HP-2435-GJ-2

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

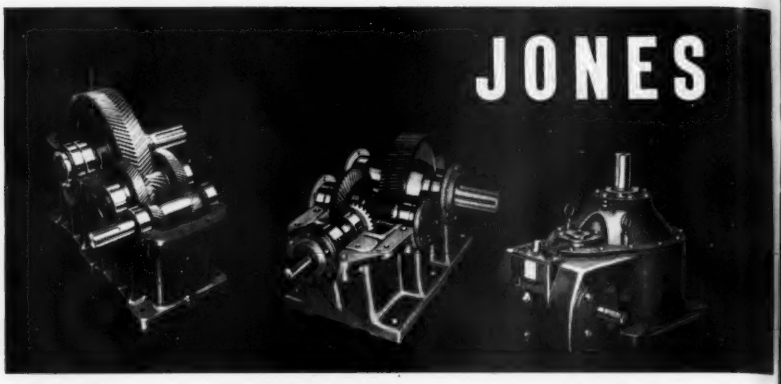
A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

How

THE BROAD H-R LINE

can pinpoint your needs, save you time and give you off-the-shelf savings.



Jones herringbone reducers...

Ruggedness and reliability, known throughout industry. Widest selection of sizes and ratios. Balanced design, rugged housing, heavy-duty bearings mean efficient, trouble-free operation, and longer life. Capacities to 1,672 hp. *Bulletin J-100.*

Jones spiral bevel speed reducers...

Most-up-to-date design. Horizontal or vertical outputs. New, highly efficient right angle drives. Matched sets of high-hardness spiral bevel gearing, oversize bearings, alloy steel helical gearing. Capacities to 1,050 hp. *Bulletin J-25.*

Jones worm helical speed reducers...

Heavy duty service. Applicable to a wide range of vertical drive requirements where medium to high speed reduction ratios are needed. Available in low speed shaft extension up, down, and double extended. Capacities to 175 hp. *Bulletin J-14.*

Union ASA standard roller chain...

Over 98% efficient, Union ASA standard roller chain transmits more horsepower in less space than many other mechanisms. Available in outstanding range of pitches and widths, ASA standard and ASA heavy series, and extended pitch. *Bulletin RT-60.*

Roller chain attachments...

An almost unlimited variety of unusual drive and conveying problems can be solved with standard or special attachments by Union Chain. *Bulletin RT-60.*

Union roller chain sprockets...

Complete range of stock and special sprockets for all chain applications. Precision teeth, tough, durable body, proper tooth surface hardness make for long life and economy. Available also in Taper-Lock bushings. *Bulletin RT-60.*

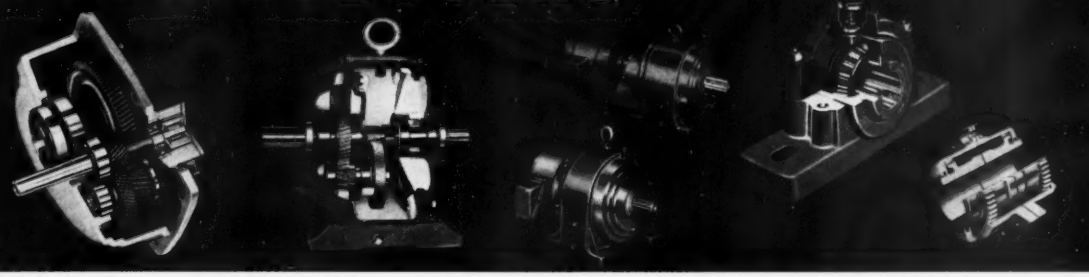
YOUR H-R POWER TRANSMISSION SPECIALIST CAN SHOW YOU HOW...

to select the ratio, capacity, and design closest to your needs . . . directly from H-R standard equipment . . . and at "off-the-shelf" savings.

Another point in your favor: your H-R power transmission specialist is in the best position to help you select the right drive. He can recommend without bias, because the H-R line is one of the most comprehensive in industry. Experienced in *all* phases of power transmission, he can be invaluable in helping you with your over-all drive problem. Important too, he has Hewitt-Robins service and reliability behind him!

Availability? H-R warehouses, sales offices, and stock-carrying distributors spread a strategic network from Coast to Coast. There is a team of H-R

SPEED REDUCERS



Jones shaft-mounted reducers...

Compact design for confined areas. High hardness gearing for long life. Double lip oil seals, anti-friction bearings, automatic overload mechanism, positive lubrication. Torque-arm for simple belt tensioning adjustment. Capacities to 40 hp. *Bulletin J-19.*

Jones in-line helical reducers...

Standardized components, both in-line and right angle reducers to meet any drive requirement. Easy-to-change ratios. One-piece, cast housing, positive gear and shaft alignment, reliable oil-sealing. Capacities to 147 hp. *Bulletin J-18.*

Jones gearmotors...

Horizontal or vertical, flange or foot-mounted. Two basic types: *All-motor* . . . has motor mounting bracket for foot-mounted motor. *Integral* . . . incorporates flange-type motor bolted directly to gearhead housing. *Bulletin J-17.*

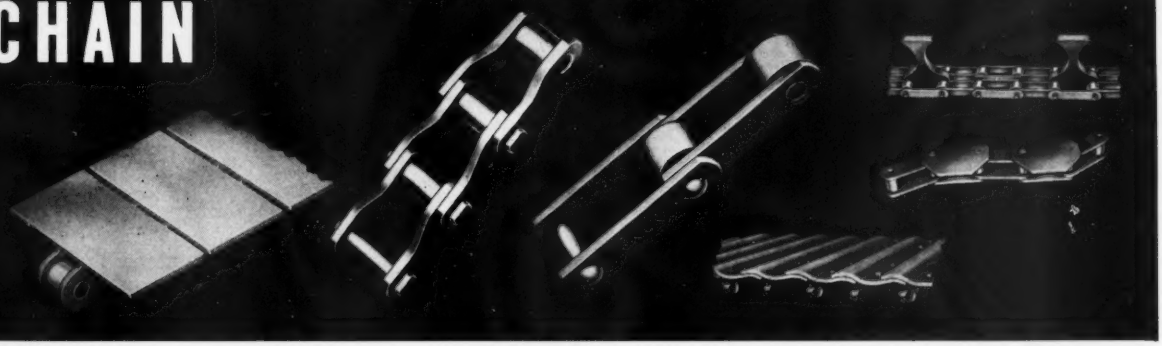
Jones power transmission components...

Pillow blocks for heavy-duty service. Timken tapered roller bearings, two-piece, cast iron housing, shaft sizes from 1 15/16" to 9". *Flexible couplings,* gear tooth, fabric disc . . . *V-belt drives . . . cut tooth gears . . . cast iron pulleys. Bulletins J-10A, J-16, J-23.*

Jones complete drive units...

Safe, efficient special drives, feeder tables, car pullers, door, boom, and skip hoists. Feature rugged reliability of Jones speed reducers. Standard lines available or modifications of existing equipment at considerable savings. *Bulletins J-11, J-22.*

CHAIN



Union ASA standard flat top roller chain...

Now available in Delrin, (as well as other materials) reduces breakage and eliminates corrosion problems in many food, beverage, and pharmaceutical conveyor applications. Available in many combinations of chain and materials. *Bulletin RT-60.*

Union HB steel drive chain...

At home in heavy duty service, such as cement mixers, cranes, shovels. Offset side-bar adds to flexibility. Hardened bearing for rugged wear. Pitches from 1.6" to 6.0". Average ultimate tensile as high as 420,000 psi! *Bulletin A-4.*

Union HB steel roller chain...

Low ultimate cost in all types of elevating and conveying duty. Hardened alloy steel bushings, uniform wearing surfaces, true pitch accuracy, tight fit of pins and bushings. *Bulletin A-4.*

Union apron conveyors...

Many types available. Union apron conveyors for bulk or packaged materials. *Bulletin A-4.*

Union "Made-to-order" chain...

Meet unusual requirements. Union Chain Division of Hewitt-Robins, unlike many manufacturers, is able to design and produce special chains to meet special needs. *Bulletin A-4.*

power transmission specialists in your territory. To put them to work for you, just give your nearest Hewitt-Robins Sales Office a call.

HR HEWITT-ROBINS

CONVEYOR MACHINERY AND BELTING • HOSE
POWER TRANSMISSION • VIBRATING EQUIPMENT
ENGINEERING SERVICES

WRITE FOR TECHNICAL BULLETINS

HEWITT-ROBINS
DEPT. 10-15 STAMFORD, CONNECTICUT

Gentlemen:
Please send me the following bulletins:

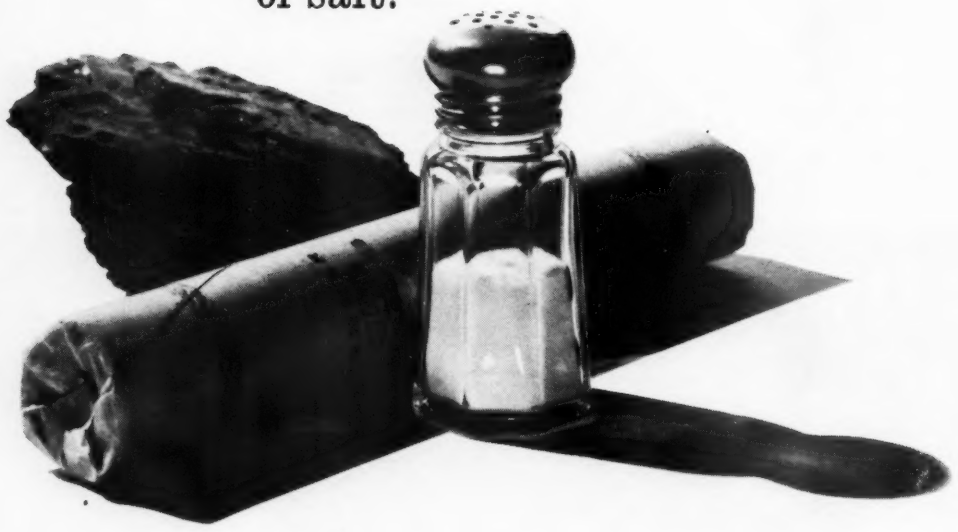
☐ J-10A ☐ J-11 J-22 ☐ J-14 ☐ J-16 J-23 ☐ J-17 ☐ J-18 ☐ J-19 ☐ J-25 ☐ J-100 ☐ RT-60 ☐ A-4

Signed_____ Title_____

Company_____

Address_____

Should you take permissible dynamites with a grain of salt?



We say yes, but not just a *grain* of salt: for increased safety all your permissibles should contain 10 per cent of salt!

After 2,400 shots in their test gallery, the U.S. Bureau of Mines concluded "that permissible explosives with salt additives are safer and that fine salt is more effective than coarse salt."

The salt has a remarkable cooling effect on the flames emitted by the explosives, thus lessening their chances of igniting gas or coal dust.

That's why every stick of permissible dynamite you buy from Du Pont contains 10% fine salt. We've been making it that way since 1958, and we are the only company to offer you a complete line of permissibles with this safety bonus.

It's easy to get this extra protection. You have a selection of 15 Du Pont permissibles to choose from—one of which will readily meet your particular underground problems—and the strongest Technical Service organization in the industry. Let us show you what this combination can do in your mine.

PROPERTIES OF DU PONT PERMISSIBLE DYNAMITES

Grade	Ctgs. per 50 lb. 1¼" x 8"(1)	Velocity ft. per sec.(2)	Water Resistance	Fume Class(4)
"Duobel" A	135	9,200	Fair	A
"Duobel" B	150	9,000	Fair	A
"Duobel" C	165	8,500	Fair	A
"Duobel" D	185	8,000	Poor	A
"Duobel" E	205	7,500	Poor	A
"Monobel" AA	120	9,000	Good	A
"Monobel" A	135	7,400	Poor	A
"Monobel" B	150	7,000	Poor	A
"Monobel" C	165	6,500	Poor	A
"Monobel" D	185	6,200	Poor	B
"Monobel" E	205	6,000	Poor	B
"Lump Coal" C	118(5)	5,800	Poor	A
"Lump Coal" CC	165	5,700	Poor	A
"Gelobel" AA	102	16,500(3)	Excellent	A
"Gelobel" C	120	12,100	Good	A

NOTES: (1) Subject to a variation of ± 3% from standard
(2) Fired unconfined with own primer, 1¼" diameter
(3) Fired unconfined with Straight dynamite primer, 1¼" diameter
(4) U.S. Bureau of Mines data
(5) 1½" x 8", since minimum diameter is 1½"

Call your Du Pont Explosives representative or distributor, or write: Du Pont, Explosives Department, 2444 Nemours Building, Wilmington 98, Delaware.

EXPLOSIVES DU PONT REG. U.S. PAT. OFF.

Better Things for Better Living... *through Chemistry*

AMERICAN MINING CONGRESS

A Declaration of Policy

ADOPTED AT SEATTLE, WASHINGTON, SEPTEMBER 11-13, 1961

THE mining industry was developed by men of daring, courage and initiative, who devoted their lives and their resources to finding and winning from our lands metals, minerals and fuels in abundance. These basic materials, produced by private enterprise, have provided the essential base for industrial growth and for our rising standard of living, and have proved a source of unyielding strength in time of war. Continued development and production of minerals on a sound economic basis is essential.

The mining industry of the United States has always known change, and has risen to the challenge in providing the requirements of our expanding economy. We reaffirm our faith in its future. The following declaration sets forth essential elements of a sound minerals policy.

FINANCING OF MINING

The advancing pace of scientific developments, the rapid growth of population, and increased consumer demands place a heavy burden upon the mining industry to satisfy the needs of the Free World for minerals and metals. As known mineral reserves are depleted or found to be inadequate in amount or kind, new and additional deposits must be found, developed and made ready for mining and processing. To do this essential job with any reasonable hope of success requires carefully planned use of the best available know-how, equipment and trained personnel, and larger and larger amounts of investment, venture, and risk capital. Governments, particularly our own Government, play an increasingly larger role in the whole economic spectrum, and establish the financial climate and often the feasibility of these mineral developments—whether the money comes from Government or from private sources or from both.

Under these circumstances, our Government should consistently reaffirm and follow at all levels the principles of enlightened free enterprise and protection of private property rights, and should weigh carefully the results of any governmental action that would make more difficult the financing of mineral enterprises by the private sector of our economy, here and abroad. Simply stated, we must know whether our Government is firmly in favor of such private investment, and whether the investing public can expect the firm backing and support of our Government at all levels.

We shall continue to oppose measures which discourage, prevent or make more expensive honest efforts to obtain the money necessary to finance mining ventures, including the so-called "premerger notification" legislation, or administrative action designed to accomplish similar purposes, unless such measures give proper recognition to the particular needs of our industry. We shall support reasonable measures to prevent misrepresentation, misapplication of funds and mala fide practices in financial transactions.

We continue to extend our offer of advice and help to all branches of Government, and particularly to the Securities and Exchange Commission, in order to insure that only measures which are constructive, sound and businesslike are adopted.

We recommend that the Department of the Interior take the initiative in a joint effort with the mining industry to strengthen and extend the program of minerals exploration loan contracts, administered by the Office of Minerals Exploration, so that sufficient funds can be made available to financially responsible and experienced parties to help promote worthy exploration projects.

Sizable amounts of money are being spent by the industry and by Government for mining and metals research. We believe there should be better integration and coordination of these efforts. A joint study covering all phases of this problem should be undertaken at the earliest possible time.

GOVERNMENT EXPENDITURES

Determined and effective action is needed to balance the budget. Federal governmental activity should not extend to those matters which the people themselves, through private enterprise or their local or State agencies, are able to carry out.

The Federal Government should not, during the period of high defense expenditures, embark on new programs not of immediate necessity.

Economic disaster lies ahead if Government expenditures continue indefinitely to exceed revenues. Government expenditures should be brought under control and substantially reduced, and tax rates should be lowered to the point of maximum revenue yield.

TAXATION

The Nation's minerals must be made available to maintain the dynamic and expanding economy which is so vital to our general welfare and to all the people of the Free World. The costs, the risks and the failures in finding and developing new reserves to replace those exhausted are constantly increasing. In order to have a continuing supply of the required minerals, profits, after taxes, must be adequate to furnish needed incentives.

With respect to income taxation, it is essential that adequate percentage depletion allowances, computed on a proper basis, be provided, and that present depreciation provisions be liberalized to provide the necessary incentive for investment of the funds required for a vigorous economy. Our present depreciation policies stifle economic growth because they fail to cope with the problem of inflation and to deal adequately with the increasingly significant problem of technological obsolescence.

State and local taxing statutes and practices which place a disproportionate share of the tax burden upon the mining industry, or which fail to provide an adequate allowance for depletion, are a deterrent to the investment of risk capital for development of the new revenue-producing properties needed to replace depleted or outmoded reserves.

We particularly urge upon the Congress of the United States the following:

Exploration expenditures should be fully deductible and present limitations on deductibility of such expenditures should be removed.

The present high income tax rates should be reduced to restore adequate incentive for investment risk, economic effort and initiative. Their reduction will benefit the economy and yield increased revenues to the Government.

The limited allowance now made to stockholders on dividends with respect to taxes paid by the corporation should be extended. The depletion allowed to a mining corporation should be carried through to the stockholder on an adequate and equitable basis. Intercorporate dividends should not be doubly taxed.

As a result of the past and continuing cheapening of the dollar, it is vital that our methods of computing taxable income be adjusted to avoid the confiscation of capital, and to recognize that most capital gains during periods of inflation of the dollar are a reflection of such inflation rather than taxable income.

The income tax laws of the United States should encourage the economic development of underdeveloped countries by private capital, rather than through the use of Government funds at the expense of our taxpayers. Profits of foreign subsidiaries should continue to be taxed only when they are distributed, and attempts to eliminate so-called "tax havens" should not penalize legitimate foreign business which is beneficial to the United States economy. Where protection of domestic production against imports is necessary, it should be provided by means other than a differential treatment in the income tax laws.

LABOR LEGISLATION

The mining industry has long advocated and supported a system of free collective bargaining through representative and responsible labor unions. We believe labor monopoly power to be incompatible with such a system and to contain the seeds of its destruction. We do not agree with those who hold that labor monopoly power has reached a point where the people of the United States no longer possess the will or the means to eliminate it. We do not agree that labor monopoly power must be accepted as an unavoidable concomitant of our modern industrial economy. Nor do we agree with those who favor mitigating the effects of labor monopoly power rather than dealing directly with its causes.

The increasing frequency of strikes which threaten the national security in a period of heightened international tensions forcibly demonstrates the necessity for realistic Congressional action. The concern of the 86th Congress over the problems of racketeering and corruption in labor unions which resulted in the passage of the Landrum-Griffin Act, while both justified and laudable, nevertheless tended to divert attention from the basic problem. Racketeering and corruption, both highly deplorable, are but symptoms of labor monopoly power. Far greater consequences of that power are the economic coercion and compulsion to which the industrial wage earners of America are subjected, the increasing domination of government through massive political expenditures by unions, the imposition on American industry of unproductive costs which diminish our ability to meet foreign competition both at home and abroad, and the hampering of vital defense efforts. These are the dire consequences which have been generated for several decades by national labor policy.

Time is running out on the free enterprise system which has made America strong. Congress can no longer ignore one of the basic causes of that situation —the privileges and immunities vouchsafed exclusively to labor unions by Federal law. Labor monopoly power cannot be eliminated by piecemeal attacks on its symptoms. Its sources must be uprooted. We urge Congress to give immediate attention to this vital problem. We recommend the following as the essential elements of effective legislation:

1. **Application of the principles of the antitrust laws to labor unions.**
2. **Prohibition of compulsory unionism in any form.**
3. **Removal of union immunity from injunctions in Federal courts.**
4. **Elimination of Federal compulsion with respect to the procedures and subjects of collective bargaining.**
5. **Effective prohibition of mass picketing.**
6. **Effective prohibition of the use of union funds for political activity.**

We oppose the enactment of legislation permitting "common situs" picketing on construction projects. This is a subterfuge to destroy the secondary boycott prohibitions of the Taft-Hartley and Landrum-Griffin Acts. We also oppose the enactment of Federal legislation setting minimum standards for the amount and duration of benefits to be paid under State unemployment compensation laws. Federal control in this field is a cornerstone of labor socialism.

Efforts to obtain legislation giving the Executive Branch of the Federal Government greater and more diversified powers of intervention in national emergency disputes is symptomatic of the tendency to deal with effects rather than causes. The national emergency provisions of the Taft-Hartley Act have operated effectively in almost every instance where they have been promptly invoked. Where political dalliance has delayed prompt action their effectiveness has been reduced. We recommend the retention of the present provisions in the law and that their use be made mandatory instead of discretionary.

IMPORT CONTROLS

Our economy requires that adequate supplies of metals and minerals be available at reasonable prices.

Adequate import duties, properly applied, are necessary to maintain certain important segments of the domestic mining industry. Where duties are required as to any metal or mineral, we recommend that such duties be imposed or increased automatically when the price falls below a prescribed peril point, and be removed or reduced when a prescribed price is reached or exceeded.

We urge that special programs in line with the circumstances be established for metals and minerals as to which the domestic production provides only a small percentage of our requirements and as to which the public interest requires maintenance of such domestic production.

When protection is accorded to any metal or mineral, such protection can become realistically effective only by establishing equivalent compensatory custom treatment on related metal or mineral items, including fabricated, semifabricated and derivative products.

Provisions should be adopted by Congress to authorize escape-clause proceedings for all metals and minerals not now eligible therefor because of the technicality that the duties thereon have not been reduced since 1934.

Import quotas should be used only when no other adequate procedure is practical and available.

We urge prompt action by Congress to implement Tariff Commission recommendations calling for simplification and clarification of existing tariff schedules.

ANTI-DUMPING MEASURES

The Anti-Dumping Act of 1921 was intended to prevent the sale of foreign goods in this country at prices less than their value in the country of origin. However, the procedures for implementing this Act, even as amended in 1958, are such that in practice domestic industry has not been provided with effective protection against dumping.

Procedures under this Act should be revised to speed up and implement findings as to whether or not foreign goods are being imported and sold at less than their fair value.

STOCKPILING

The Nation's stockpiles of strategic minerals and metals should be filled and maintained at adequate levels. These stockpiles should be used only to meet security requirements. Concepts of national defense requirements change radically from time to time; an apparent surplus today may develop into a serious shortage tomorrow.

Experience has demonstrated that stockpiled materials, if subject to release by administrative action, present a continuing threat to orderly markets. Therefore, stockpiled materials should not be subject to release for any purpose except pursuant to a plan formulated in consultation with representatives of the industry involved, and with the approval of the appropriate committees of the House of Representatives and the Senate. Further, any such plan should provide for sale only through domestic producer-marketing channels and in a manner and at such times that prices and established markets will not be adversely affected.

BARTER

The barter program has been useful in assisting the Government to implement stockpile objectives. Under current conditions, however, its usefulness as to metals and minerals is exceedingly limited. Under no circumstances should barter be utilized (1) to supply Government requirements for minerals or metals which are available from domestic sources, (2) to acquire materials for which stockpile objectives have been met or (3) as an expedient in lieu of a realistic solution of the problem of surplus commercial stocks.

SOLID FUELS

Recognizing the importance of our natural fuel resources to our economy and to our security in the prevailing tense international situation, the sound development of our energy resources is clearly required.

Coal is the primary fuel upon which the Nation can rely during any emergency and for centuries to come as an assured source of low-cost energy. It is essential that the productive capacity of the coal industry and the facilities for transportation of coal to our industrial centers be safeguarded. This was demonstrated by the Nation's experience in World War II, when the availability factor for other fuels rapidly reached the danger point.

To assure a solid fuels industry adequate to protect the national welfare and security, we recommend:

1. **A Congressional study of the Nation's fuel resources and their availability in peace and in war, including an appraisal of the coal industry's capacity to meet the requirements of any future national emergency; such study to provide information which will enable Congress to determine what policies may be necessary in the national interest.**
2. **Adoption of sound economic and conservation principles governing the sale and distribution of energy fuels.**
3. **Adequate mandatory restrictions on importation of residual fuel oil, crude petroleum, and refined products.**
4. **Liberalizing the percentage depletion allowance for coal and lignite, in recognition of the greatly increased replacement cost of coal mines.**

MONETARY POLICY

The need for a more stable dollar has become critical not only in the domestic but also in the international economy. Unsound fiscal practices and monetization of the debt have weakened the dollar and impaired its usefulness as an international currency, and have contributed to the continuing gold drain.

Continuation of these policies would result in the exhaustion of our gold supply, with disastrous consequences both for our domestic economy and for the Free-World community.

The need to restore confidence in the dollar is urgent. A dollar that serves to meet the international responsibilities of the United States can no longer rest primarily upon public debt obligations. Only a dollar based adequately upon precious metals can discharge this function. This demands an immediate and far-reaching reform of the monetary system.

To effect such reform may call for a temporary embargo of Treasury sales of gold at the present price of $35 an ounce, and an ultimate redefinition of the dollar in terms of a more realistic price for gold.

The achievement of these objectives will not be easy, but a start must be made.

GOLD

We recognize that gold is the basic international monetary commodity, and we oppose as inimical to the best interests of the Nation any proposal to repeal or to reduce the required gold backing of our currency. We believe that confidence in the dollar is more likely to be restored by raising than by lowering or abolishing the gold reserve requirement. Treasury policy of selling gold to foreign central banks and to selected fabricators at home at $35 an ounce has resulted in a gold drain that today threatens the integrity of the reserve and the value of the dollar.

We therefore recommend the following essential steps toward reestablishment of a workable gold standard:

1. **Removal of restrictions on ownership, purchase or sale of gold by American citizens.**
2. **Cessation of Treasury sales of gold for industrial purposes; such requirements should be met by the market at freely negotiated prices.**
3. **Redefinition of the already depreciated dollar in terms of gold, and convertibility to and from gold.**

SILVER

Although the monetary usage of silver in the Northern Hemisphere is limited largely to subsidiary coinage, it has historically been the paramount metal of money in the Southern Hemisphere and in Asia, and has played a significant role in two world wars, both as a monetary and as a strategic metal.

The rising demand for silver in industry, and its increasing significance in a space-age technology, give importance to increased production of new silver and to the maintenance of strategic reserves of silver. The monetary reserve of the United States is the last major supply of silver in the world and this reserve must not be dissipated.

To encourage the production of new silver and the maintenance of substantial silver reserves, we urge that Congress and the Treasury act to:

1. **Discontinue sales of Treasury silver at less than the monetary value.**
2. **Restore a free market for silver for both spot and future trading through repeal of the tax on silver transactions.**
3. **Continue to acquire silver for monetary and strategic purposes, in accordance with established public policy and at prices conforming to free market indications.**
4. **Hold for monetary and strategic use all present stocks and future acquisitions of silver.**

URANIUM

Since all domestic uranium purchase contracts with the U. S. Atomic Energy Commission will expire before January 1, 1967, the uranium industry must look to the AEC for guidance in order to evaluate the industry's future prospects. To this end, we urge that the Joint Committee on Atomic Energy and the AEC undertake immediate studies to determine:

1. The Government's policy with respect to uranium purchases after 1966.
2. Whether domestic reserves of uranium are sufficient to meet long-range military and civilian requirements.

The findings from such studies should be made available in sufficient time before January 1, 1967, to permit the industry and the communities where uranium mines and mills are located to make such adjustments as may be needed by reason of any proposed changes in the Government's program.

We urge that the AEC continue to study the whole question of substituting other developed ores for existing ore quotas under current procurement contracts, and afford the industry the widest possible latitude consistent with AEC procurement goals in making such substitutions.

MINE SAFETY

Mine safety will always be a major responsibility of the mining industry. Safe working conditions, together with new and better means of promoting safe working habits through unceasing educational effort, are primarily the responsibility of individual mining companies.

It is increasingly evident that success in safety is dependent upon individual responsibility encouraged and exercised at all times at all levels of supervision. Basic principles of safety apply everywhere, yet special problems require special solutions. We maintain that the mining industry itself is best qualified to solve its safety problems, as attested by its steady and impressive progress in the safety field.

We recognize that State mining codes or regulations together with State inspections may be useful and necessary, but we are opposed to any duplication of mine inspection activities by Federal agencies.

The mining industry commends the work of the U. S. Bureau of Mines in promoting safety education and accident prevention, and will welcome intensified efforts by the Bureau in this important field.

GOVERNMENT REORGANIZATION

As a means of restraining the constantly rising cost of Government, we have consistently advocated action on the Hoover Commissions' recommendations for reorganization of Federal agencies, consolidation of bureaus having overlapping functions, and elimination of waste and inefficiency. We continue to advocate such action. Economy and efficiency in government should be a foremost concern of political parties and civic organizations.

U. S. GEOLOGICAL SURVEY— BUREAU OF MINES

Again we express our confidence in the administration of the U. S. Geological Survey and the Bureau of Mines. Their work in the fields of research, mine safety education, mineral exploration, and topographic and geologic mapping should be adequately supported on a continuing basis. The mapping program of the Geological Survey should be accelerated.

WATER AND AIR POLLUTION

The ever-increasing levels of human activity and population concentration, combined with specific geographic factors, cause water and air pollution problems which are usually local in nature and the effects of which are generally limited to nearby areas. Such problems must logically be approached on an individual and local basis.

We urge that Congress and the Executive Branch recognize the local character of water pollution problems, and establish Federal policies giving full support to the local, State and interstate agencies which have the basic responsibility for solving these problems.

We commend Congress for its continued recognition of local responsibility in matters of air pollution.

The Federal Government should assure that local, State and interstate water and air pollution control agencies retain maximum authority in determining the abatement requirements in affected areas, and in administering the distribution and use of such Federal funds and technical assistance as may be made available.

PUBLIC LANDS

Our military strength and economic growth are dependent upon the full utilization and development of the productivity of our public lands through private enterprise.

We believe that the public interest is best served by keeping the public domain open for the discovery and mining of minerals, both metallic and nonmetallic. No area of the public domain should be closed to prospecting and mining nor should any area which is now so closed be enlarged, either by Congressional or by Departmental action, unless it is established by proper examination and appraisement by the U. S. Bureau of Mines or the U. S. Geological Survey that the closing of such area will far better serve the national welfare than will the full utilization of the lands involved for development of their potential metallic or nonmetallic mineral resources.

Existing withdrawals of public domain lands should periodically be reviewed and reduced, and future withdrawals should be restricted, to the end that the acreage of public lands closed to prospecting, locating, and mining be kept to a minimum.

The enactment of any measure or the establishment of any rule, regulation, determination or order of any executive agency which would prohibit, preclude, obstruct, or limit access to or utilization of the public domain for the purpose of prospecting, locating, and mining natural resources is contrary to the best interest of the States directly affected and of the Nation, and is vigorously opposed by the American Mining Congress. We specifically oppose the so-called Wilderness Bill, and condemn recent actions of the U. S. Forest Service in requesting withdrawal of large acreages of land for the specified purpose of precluding the location of mining claims.

The system established by the General Mining Laws for the location and patenting of mining claims has proven successful in encouraging and providing for development of the mineral resources of the public domain through private initiative and enterprise; however, in order to facilitate the discovery of deep-lying ore bodies, we favor legislation which will, without destroying the principle of our present mining laws, afford reasonable prediscovery protection to one who is in good faith engaged in seeking a discovery.

We believe that any holding that a mineral deposit is not a "valuable" mineral deposit or that it has no "economic value" where the claimant has expended or is willing to expend substantial sums in exploration of the deposit, or in development of the means or processes to put the deposit to use, is not in accord with the mining laws. The fact that value lies in potential as well as in present use has been demonstrated by experience.

We believe that the original concept of "discovery" as developed by judicial decision is the correct concept, and we urge that it be made mandatory upon all departments of the Executive Branch of our Government. The Bureau of Land Management should be required to follow the decisions of our courts which established the measure of discovery, and should not create its own definitions in disregard of long-standing precedents.

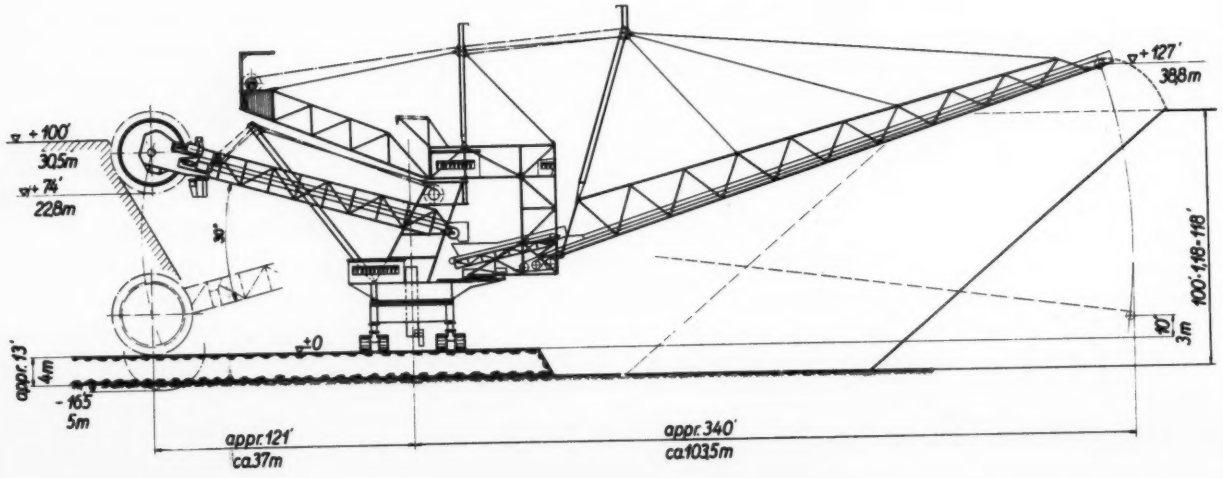
We recognize the problem presented by the extension of urban areas upon lands the surface rights of which are privately owned and the mineral rights within which have been reserved to and are held by the Federal Government. It being inherent in our law and vital to the public interest that mineral deposits in such lands be discovered and developed, we reaffirm the right of the prospector to search for and develop such mineral deposits. We favor legislation which in such cases will require the payment of just compensation for actual damage to the surface and to the improvements situate thereon resulting from mining operations. Only where "urban areas" have been built upon the surface of land the mineral rights in which are reserved to the Federal Government, and such urban areas contain population in excess of 100,000 and lie within the boundaries of an incorporated city, and the damage caused by mining operations would not be amenable to monetary compensation, should thought be given to transferring the reserved mineral rights to the owner of the surface. "Urban areas" should be determined by the actual fact of inhabitance, not by the declaration of any agency, State or Federal.

We believe that when any licenses are sought for the construction of dams and reservoirs which would make inaccessible known mineral resources, such mineral resources must, in the public interest, be given priority, and the construction of such dams and reservoirs deferred until the mineral resources have been depleted. If the order is reversed, the mineral resources will be lost forever. In the case of geologically unknown or unexplored areas to be inundated, investigations should be made by the U. S. Geological Survey and the Bureau of Mines to appraise the mineral possibilities of such areas.

The prevailing rule that the validity of administrative rulings of the Secretary of the Interior with respect to mining claims can be challenged only in a proceeding brought in the District Court of the District of Columbia places an undue burden on owners of such claims. We favor legislation conferring jurisdiction to review such determinations on the U. S. District Court in the district in which the mining claims are situated.

We believe the executive agencies should administer the General Mining Laws, as amended, in accordance with the terms of those laws and the intent of Congress as expressed at the time of their enactment or amendment. Such Congressional intent should not be thwarted or distorted by administrative rulings or determinations.

We urge upon the Department of Agriculture and its Forest Service, and upon the Department of the Interior and its Bureau of Land Management, that their regulations be administered uniformly to the end that the development of our natural resources may be prosecuted without undue burden.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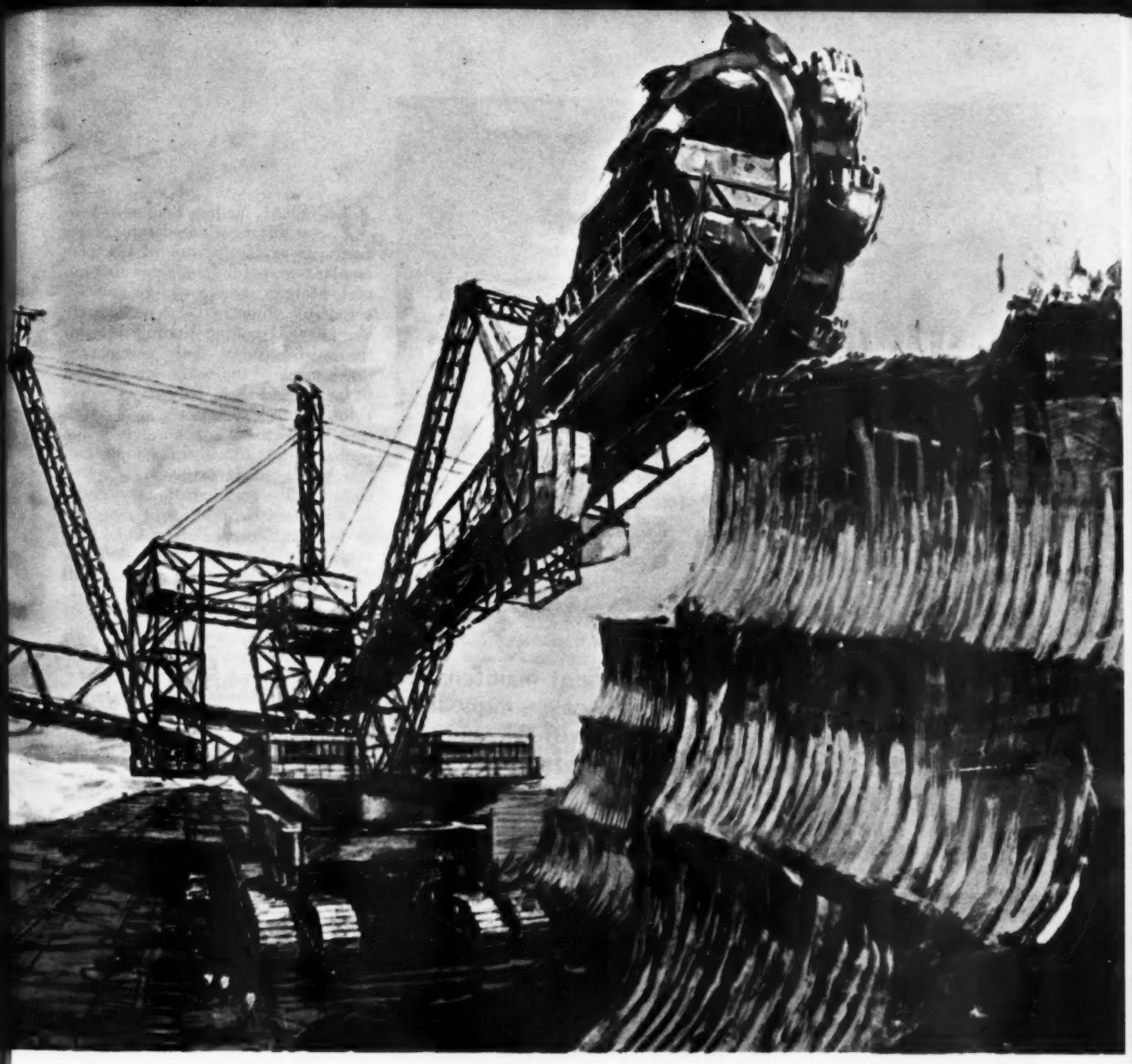

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Maintenance

At Moss No. 3 Mine

By Ballard Taylor
Assistant Superintendent of Maintenance
Moss No. 3 Mine
Clinchfield Coal Co.

"An efficient maintenance program pays immediate dividends with virtually no capital investment"

Through a telephone system section foremen report hourly to the central maintenance office. In this way an accurate record is kept of the down time of machines such as this 15-SC shuttle car

GENERAL Nathan Benjamin Forrest of the Confederate States Army, in explaining one of his spectacular successful campaigns to General Morgan and a fellow officer, coined the phrase, "that it was merely a matter of getting there first with the most." Today, daily newspapers make much of the profit squeeze that is facing American industry. Competition for each sales dollar is at an all time high. This is true not only in the coal industry, but in those industries which are endeavoring to supplant coal. For the coal industry to remain in a competitive position it must try to do what General Forrest did a century ago, "Get there first with the most." When it does its product will stand and remain in a favorable competitive position. To get the most, and how to keep getting the most, which will in turn let us sell at a favorable competitive price, is what brings us to the discussion of the maintenance program at Moss No. 3 mine of Clinchfield Coal Co.

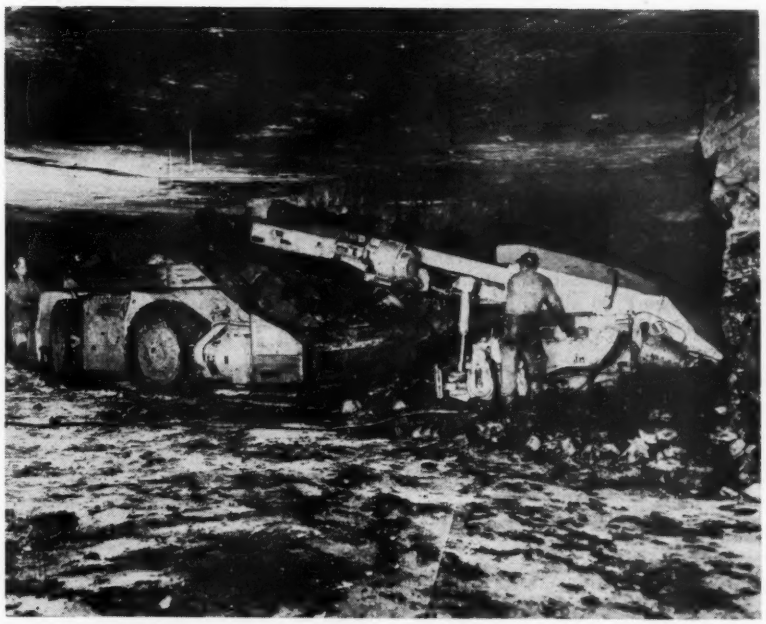
The maintenance program is directed by the assistant division superintendent in charge of maintenance. The program is divided in two categories: First, preventive maintenance and, second, on-the-spot or breakdown maintenance. Preventive maintenance is a planned system of repair work to get the maximum efficiency from our equipment. It prevents breakdowns through a systematic inspection of equipment and repairs before failure occurs and thereby prevents interruptions to production. On-the-spot, or breakdown maintenance, is defined as; taking care of failures and breakdowns of machines and equipment during the production shift at which time only the repairs necessary to get the piece of equipment into production are made.

Production Equipment Inspected Every Four Days

The preventive maintenance crew consists of five mechanics and a foreman. Every fourth day all of the equipment of a regular production unit is made available to this staff of repairmen for a thorough and systematic check. This manner of making an entire production unit available is done by transferring or rotating the regular production crew to a spare section in the mine. The preventive maintenance crew reviews

the assistant chief electrician's report, which he has written on his inspection on the previous shift after the crew has completed their reports, and starts a systematic check for any defective or worn part of the equipment. It replaces all parts which are deemed to be a potential failure or breakdown. In a word, this crew tries to foresee and forestall any mechanical failure which might happen to the production equipment.

To facilitate the work of the preventive maintenance staff, a supply car has been designed which carries all the spare parts that may be needed. Actually, the car is a miniature rolling supply house. This car is taken with the crew right on the section designated for their services. It was designed especially to do away with lost time, wasted time or waiting time. Before the advent of the maintenance supply car, much time was consumed by the foreman, and sometimes by the mechanics in trips to the central shop or supply house for repair parts. Now the parts are with them on the section at their finger tips as they may need them. Result? No time lost in calls, trips or waiting.



Every fourth day regular production equipment is made available to the preventive maintenance crew. The production crew is rotated to a spare section in the mine

Mechanic at the Site of Breakdown Within Minutes

The on-the-spot or breakdown maintenance is handled in two ways. At two of the four portals of the mine there is an underground centrally located shop. This station is staffed by four mechanics and a foreman. At the other two portals of the mine a mechanic works on the section with the regular production crew. The reason for this two system plan of maintenance is to evaluate the controversial question as to whether it is better and more efficient to have a repairman as a regular member of a production crew or dispatch one from a centrally located underground shop when necessary. Records of the downtime on equipment under both systems are being carefully compiled. At this time no conclusive deductions have been made as to which of the two systems is the better.

In the mines having an underground shop the mechanics, when not on call, busy themselves at repairing and reclaiming small parts and making the necessary repairs to the transportation buses and locomotives. Transportation for the mechanics is kept available at all times. They have for their private use mine jeeps and locomotives. Thus a mechanic who receives word of a breakdown can be on the section and at the scene of the mechanical failure within minutes after he is notified.

At the underground shop a supply of spare units such as the various hydraulic jacks, speed reducers, motors, tires, etc., are kept on hand. In fact, the inventory of underground shops contains a spare unit or replacement for any piece which may fail during the production shift.

Broken and damaged major units which are changed out are immediately dispatched to the main shop for repairs. A trade out system is in operation whereby a replacement is exchanged for the damaged or worn unit at the time it is delivered to the main shop. Thus the inventory of replacements at the underground shop is kept constant.

In the mines where the mechanic is attached to the regular production unit, he is limited to the necessity of maintaining the equipment; there is so little downtime on the equipment on any one section that in order for the mechanic to keep busy the foreman has him operating equipment and doing utility work. In other words, he is only another man added to the production crew and charged to maintenance. If the equipment on a production section is in such a stage of repair that it requires a mechanic on the section at all times, then it is time to idle the equipment for preventive maintenance or dispatch it to the main shop for a complete overhaul.

In most cases when a mechanical failure occurs on a section a mechanic is dispatched from another part of the mine or from the main shop. However, as previously stated, this is a controversial question which is in the process of being evaluated.

All belt conveyor drives, sub-stations and air compressors are powered by alternating current. Consequently, there is a maintenance crew whose sole responsibility is the care of the a-c equipment. The necessity for this special set up can be readily seen when one realizes that the ordinary mine mechanic is far more familiar with the behavior of direct current. The a-c maintenance and repair crew consists of four men, two of which check and service all the air compressors each day. The other two take care of all the belt conveyor drives, and the sub-stations. Daily records are kept on the inspections made by these four men. Any parts which show wear and contain a potential breakdown to the main conveyors are changed out on the off days or when the mine is idle. Any changes necessary on secondary belt drives are made at the time the section is made idle for the preventive maintenance crew. When repairs are necessary for the air compressors the

same procedure is followed. Valves are changed while the section is idle for repair. Thus with a systematic check and re-check the a-c system at the mine is kept at peak performance, with very little downtime encountered.

Records Reveal Equipment Downtime

A system of maintenance records has been developed to keep an accurate daily, weekly, monthly and yearly record on all of the downtime for each piece of equipment in the mine.

In the office of the maintenance superintendent there is a central telephone system. It is manned by an operator around the clock, three 8-hour shifts per day. The operator is in constant contact with every operating section of the mine. He receives an hourly report from each section foreman as he progresses through his entire working shift. Thus, if any piece of machinery, such as a cutting machine or a loading machine breaks down, the section foreman notifies the operator, giving him an account of the nature of the breakdown and the exact time it occurred. A record is made of the piece of equipment which is "off the road" and the exact time at which it broke down. When the necessary repairs are completed and the piece of equipment is back in production, the central operator is again called. This time he is called by the mechanic who made the repairs. The exact time the machine went back in operation is reported to the central operator. Thus an accurate, to the minute account of the downtime is on the record.

In the office of the central operator there is also a series of electric clocks. Each clock is connected to the controls of the primary belt conveyors. Some belts are located five miles from the central office. When the belt stops, so does the clock. Immediately the central operator will dispatch someone near the belt drive to start it. When the belt is started the person who started it will call the central operator and report what had shut the belt down. At the end of the shift the time difference is recorded along with the reason why the belt was down. At the end of the month the time is totaled and divided by the number of shifts operated. This figure often is as low as one minute per shift. Those figures are then transferred over to the monthly report and distributed to all concerned.

A continuous and cumulative record of downtime is kept on every every piece of equipment throughout the mine. Thus at the end of the week or at the end of the month any excessive amount of downtime can be spotted immediately. Such a record system provides a positive indicator as to when any piece of equipment is ready for a general over-haul job at the main shop.

The main shop is located at the "A" and "B" portals of Moss No. 3 mine. It is staffed by a general shop foreman and 14 mechanics. All major repairs are made at this shop. Equipment which has been extensively damaged is also rebuilt here. No equipment is ever dispatched away from the mine for repairs.

Major repairs of equipment such as this 15 BU loader are made at a central shop which is staffed with a foreman and 15 mechanics

Four Cardinal Principles for a Successful Program

This, then, is a picture of the maintenance program as it exists at Moss No. 3 mine. There are four cardinal principles which are deemed most necessary for the success of the program.

The first is lubrication. From the time a new piece of equipment is received, the first concern is to see that it gets the proper amount of lubrication—and keeps getting it.

The second is care of the equipment. Machinery is not subjected to unnecessary roughness or abuse.

The third is a foreman with the know-how with good mechanics and the proper tools.

The fourth and final ingredient of a successful maintenance program is the support and cooperation of the top management. Without any one of the four ingredients the maintenance program will be a failure.

Nobody needs to be told, least of all management, that the coal industry is looking for new ways to boost the tons-per-man rate. That's why forward looking operators are beginning to take a closer look at the maintenance practices in their mines.

Maintenance today is an exact science and the reward of treating it as such can pay off in an increase in tons-per-man and a dip in maintenance cost. In other words, an efficient maintenance program pays immediate dividends with virtually no capital investment.

In the vast majority of mines, maintenance practices have not kept pace with the rapid mechanization of mine operations. Any neglect of proper maintenance will inevitably result in excessive downtime.

Chief electricians and master mechanics are doing their best to combat the problem, but they need management's support. Those who have investigated this problem have found that production on a long term basis can only be achieved by eliminating those practices designed to provide a short-term gain. This means a planned maintenance program operated on a year round basis.

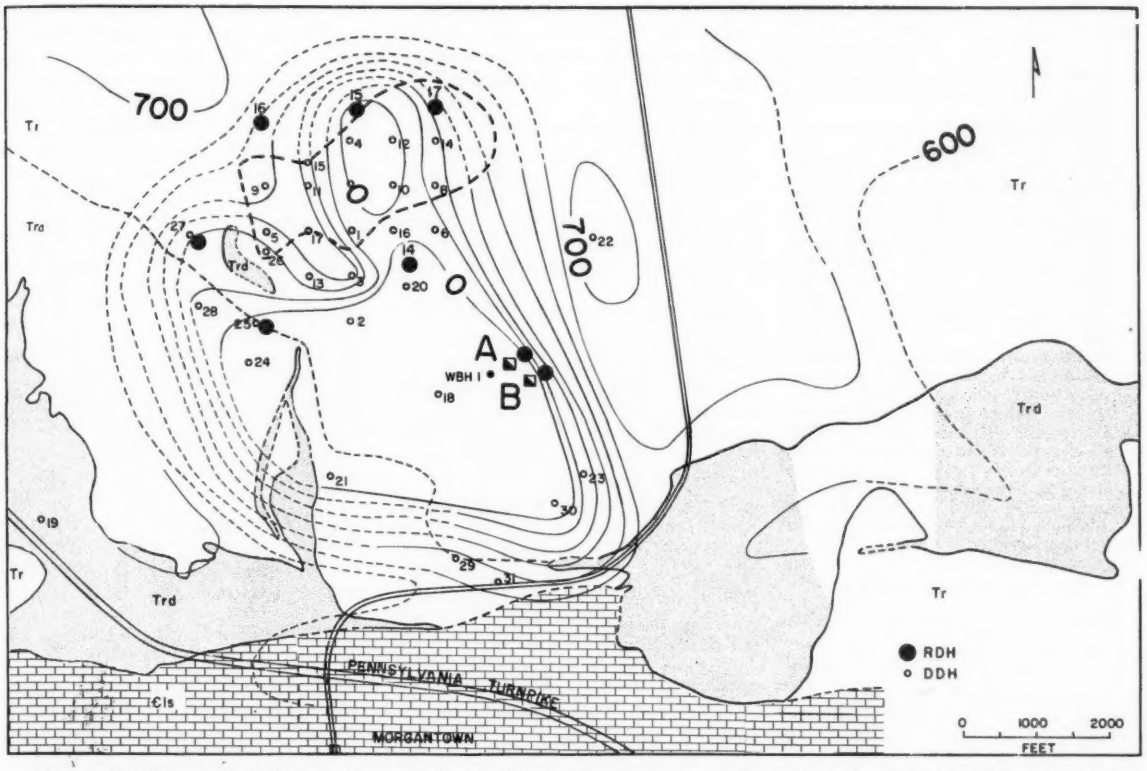


Fig. 1. Sketch map of the Grace mine area, showing the surface geology, ore outline, wells and piezometric surface as of January 1956. Designations on the map and their meanings are as follows: RDH, rotary drill hole; DDH, diamond drill hole; WBH, churn drill hole; Trd, Triassic diabase; and Tr-Tri, Triassic sedimentary rocks and alteration rocks near diabase

Ground Water Control at Grace Mine

The dewatering program at Grace mine materially helped shaft sinking through broken and permeable ground, and it has reduced water flow through the ore and maintained it at relatively low volume

G. K. BIEMESDERFER, Geologist
and
R. H. LESKE, Mining Engineer
Bethlehem Steel Co.

THE Grace mine ore body at Morgantown, Pa., is an airborne magnetometer discovery that was explored by diamond drilling during the years 1948–1951. While drilling was in progress, the probable need for ground water control became evident, since many of the holes began to have water flows at the surface. Flow volumes increased as the holes penetrated a series of aquifers at depth and persisted with little diminution during the exploration stage.

Need for Ground Water Control Foreseen

It was anticipated that ground water would not only hinder shaft sinking, but it would create handling problems with the magnetite ore that was to be extracted by block caving. The mine haulage and dumping systems were designed for efficient handling of wet, sticky ore, but efforts were made to circumvent the water problem as far as possible.

In order to obtain relief from high-volume flows, a dewatering program was begun first in the shaft area, then later in the ore body area ahead of cave development. Dewatering was effected by pumping from deep wells with high-head submersible pumps, in the hope that sufficient water could be withdrawn to lower the water table substantially.

Two concrete-lined circular shafts were planned for ultimate depths of 3000 ft. Shaft sinking and dewatering started in January 1952, and both projects advanced concurrently.

Hydrologic studies of surface water and ground water have been continued since that date to follow the areal drawdown and to help guide future dewatering efforts. The study re-

vealed the following major hydrologic characteristics:

1. **Both water table and confined aquifer conditions existed prior to development.**
2. **Perched water tables continue to exist north and east of the mine and continue to provide shallow water supplies for domestic use.**
3. **Confined aquifers in the monoclinal structure outcrop in the mine area and recharge through precipitation and surface bodies of water. One surface stream in the cone of depression has become entirely influent; another is influent in low rainfall years.**
4. **Yields from confined aquifers are influenced by impermeable boundaries which are faults and lenticular and interfingering sediments.**
5. **The diabase footwall dike provides an impermeable boundary that confines drawdown effects to the rocks above it. Ground water in the limestone valley south of the dike has not been affected by pumping from the mine area.**

Complex Geologic Setting

The geologic section at Grace mine consists of Cambrian limestone overlain by a 1500 ft to 2400 ft sequence of Triassic quartzite, sandstone, red siltstone, and red shale. The Cambrian-Triassic contact occurs at the surface just north of the village of Morgantown and forms the northern edge of Conestoga Valley (figure 1). In the subsurface the contact dips about 30° northeast toward the center of Pennsylvania's Triassic trough.

Within the Triassic rocks, thin diabase intrusions occur as sill-like masses and also as dikes. A major dike at least 1200 ft thick has a cross-cutting relation with the buried limestone and crops out near the limestone-Triassic contact at Morgantown (figure 1).

Triassic sedimentary rocks in the mine area strike N 40° W and dip 20°–25° to the northeast, but the regularity of strike and dip is disturbed by numerous high angle faults that repeat the sequence of beds. Continuity of individual beds within the Triassic is limited both by faulting and by sedimentation. Lenticular beds thicken and thin within short distances so that correlation of beds between the exploration holes was difficult. For example, within the confines of the shaft excavation six-ft thick sandstones were observed to pinch out entirely to shale or siltstone.

In the Conestoga Valley, south of Grace mine, the Cambrian limestones and shaly limestones are tightly folded and faulted into structures that parallel Appalachian trends. Similar complex structures are observed in the subsurface and may have some control on the localization of ore.

The ore body is confined to the wedge-shaped limestone zone between the diabase footwall and Triassic quartzite hanging wall. The ore is replacement material almost identical to that of the Cornwall mine and of similar origin. Ore is finely crystalline magnetite with sulfides in the form of pyrite and pyrrhotite. Gangue minerals are mainly carbonates, tremolite, chlorite, and serpentine.

Peak Flow in Shaft B was 613 GPM

Previous to the discovery and development of Grace mine, there had been little knowledge or experience with the hydrologic properties of the rocks in the area. The artesian flows from the Triassic rocks presented a possible problem, and the limestones in Conestoga Valley were known to contain solution cavities. Whether pre-Triassic solution cavities existed or not was an unknown factor, although no evidence of solution was noted in the 18 diamond drill holes put down for exploration.

Observation of the rocks exposed during shaft sinking revealed that major aquifers were limited to the upper Triassic section. Primary porosity in the conglomerates provided part of the flows, but fracture porosity yielded the major quantities. Both A and B shafts intersected high angle faults that persisted inside the excavation line through most of the shaft depths. Maximum flows occurred, (1) at the junction of the faults and the lower contact of diabase sills, and (2) at the junction of faults and shattered quartzite. The faults also served as low permeability barriers where gouge or breccia was not present or was tightly cemented.

Below 1500 ft, the Triassic rocks were much less permeable and faults were tight. In the limestones, although they are extensively faulted, there was little or no water encountered. No open solution cavities were observed, and the Cambrian-Triassic contact was a tightly cemented limestone conglomerate. The diabase footwall likewise yielded no flows.

Since this was the first experience with shaft sinking in this type ground, the design of bottom pump capacity was based largely on the physical size of pumps that could be handled efficiently at the bottom. The bottom pumps were a 25-hp self-priming suction pump that delivered to a 50-hp pump mounted on the same frame. The combined units had a capacity of 300 gpm at 400 ft head, but needed an additional pump when flows exceeded 300 gpm. These pumps lifted water to temporary intermediate stations that relayed water to the surface.

This capacity was adequate except for several cuts that were made around the 1000 ft depth. In Shaft A, a peak flow of over 300 gpm was encountered, accompanied by a large volume of fault gouge that clogged pump strainers and caused delay in recovering the bottom. Longhole drilling ahead of this elevation (1022 ft depth) indicated additional flows under pressures up to 140 psi. Anticipating over-capacity flows at this point, a concrete plug was poured and the shaft pre-grouted for 100 ft ahead of sinking. When B shaft reached 1230 ft depth, and with a similar geologic situation, the peak flow reached 613 gpm. It was while shaft progress was slowed that the beneficial effects of the dewatering pumps could be accurately measured and the barrier effect of faulting was determined from the quantities discharged by the ring of grout holes.

Well Drilling Footage Exceeded 28,000 Ft

It was first hoped that 24 in. churn drill holes could be completed successfully to contain the large diameter submersible pumps, and production from one such hole 922 ft deep (WBH-1) began on January 10, 1952. Subsequent attempts to drill deep churn drill holes failed mainly because of the soft and faulted character of the Upper Triassic rocks. High-angle faults caused deflections, and soft red shales caused serious caving difficulties. Of the three succeeding attempts at churn drilling, one deflected into the shaft excavation line, and the other two were halted by broken tools in the hole. Churn drilling was then abandoned in favor of rotary drilling which promised more rapid delivery of a completed hole, but which required the use of small diameter pumps.

Eleven 12¼ in. holes with an aggregate depth of 18,248 ft were drilled adjacent to shafts A and B (RDH 1–11). Six 12¼ in. holes totaling 10,201 ft were drilled on the periphery of the ore body. One of the latter (RDH 16) was reamed to 24 in. diam to a depth of 1621 ft in order to accept a large diameter pump.

The 12¼ in. rotary holes were equipped with 9⅝ in. slotted casing and submersible pump assemblies suited to such size. Pump capacities and types varied widely depending upon the discharge head and yield of the hole. The number of stages ranged from 20 to 69; horsepower ratings ranged from 100 to 240.

Power supplied to the pumps in the hole was 2300 volt 3 phase. Discharge pipe holding the pump assembly was 5½ in. OD.

Factors that Influenced Well Locations

The initial yield of the wells varied from 1100 gpm to 200 gpm, the differences being due to the pumping influence of previously installed neighboring wells, low storage capacity of the aquifers, and construction activities in the shafts. The best producer was WBH #1, which withdrew water from storage at 1000 gpm seven months before the rotary drill holes began production, but its immediate effect on Shaft A was not as helpful as desired, and additional capacity was necessary.

Factors that influenced the location of the wells in the shaft area were as follows:

1. Available physical space for drill rig, mud pumps and supplies near the shaft collar.
2. Anticipated deflection of the hole.
3. Total rate of discharge from the wells compared with flows in the shafts.
4. Frequent pump failures required the drilling of additional standby holes to maintain steady water withdrawal.
5. Fault barriers that isolated blocks of ground water.

In the ore body area, location factors were:

1. Zones of slow drawdown as shown by piezometric maps.
2. Projected cave limits at the surface.

Maintenance experience with the small-diameter pumps was poor. In order to sustain production of ground water, a total of 81 pump replacement installations were made in the 16 holes that had been completed (See figure 2). The majority of the failures were due to electrical breakdowns.

Despite the frequent failures, withdrawal of water was maintained at a rate of 1000 to 1800 gpm which produced a continued lowering of the water table surface, and reduced pressures at the shaft site.

Mine Water Used for Mill Make-Up Water

Observations of the dewatering effects were made regularly in the exploration diamond drill holes, which were equipped with 500 to 600 ft of AX casing, and at 198 other points in the surrounding area. With pumps operating only in the shaft area until July 1954, the piezometric surface showed a steep slope that trended northeast-southwest through diamond drill holes 13-1-10-14. At that time the lowest closed pressure contour around the pump area was at elevation +200, or a drawdown of about 400 ft from the original surface.

Continued pumping and subsequent drilling of rotary drill holes (RDH 12 to 17) around the ore body resulted in a below-sea level cone of depression in 1956 that included the shafts and part of the ore body. A "resistant" ground water ridge, believed to be isolated by a fault barrier, was present in a belt through DDH's 9 to 3. The net change in the deepest part of the cone has been at least 600 to 700 ft (See figure 2).

Since drawdown has exceeded the limits of casing in the observation holes, the effect of continued withdrawals has been looked for in the quantities of water coming into the caving ore. Figure 3 shows that the flows developed in the production panels have become fairly constant although the undercut area has expanded and caving is known to have progressed at least 200 ft into the hanging wall.

In order to divert water from the cave area, it has been necessary to pump increasing amounts from the wells, but this has provided a secondary benefit. Make-up water requirements for the concentrator and pellet plant are about 1100 gpm, which cannot be supplied on a regular basis from surface streams; however, the clear water pumped from the mine supplements the stream flows to the mill-water pond and balances the deficit.

The cone of depression southwest of the shaft area presented a problem to the construction of the 16-acre mill-water pond since measurements along the course of the surface stream in the pond area showed a loss of up to 100 gpm due to influent seepage. In order to reduce these losses, the reservoir bottom was treated with compacted clay lining which had a

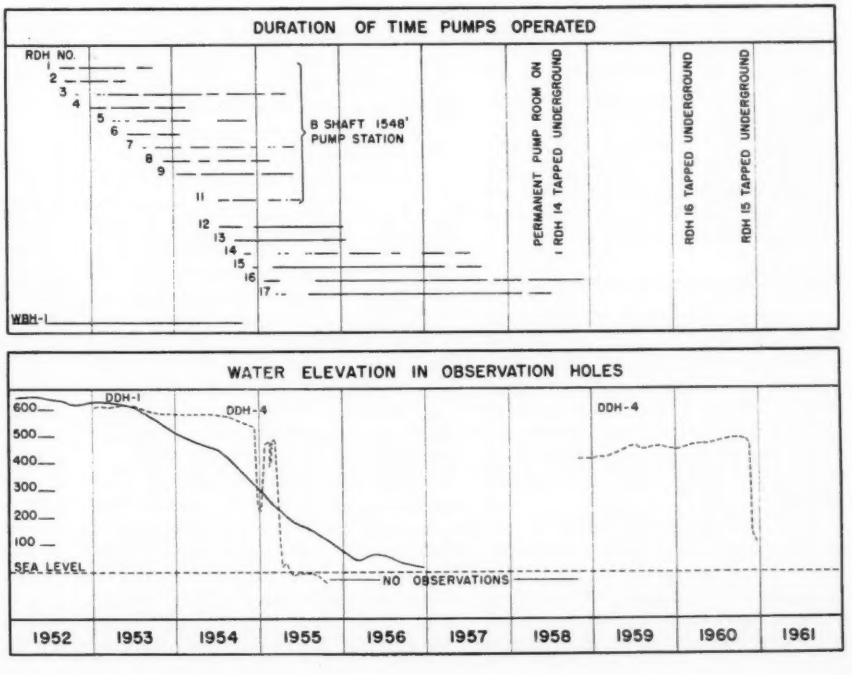


Fig. 2. Continuous withdrawal of groundwater in the shaft area in 1952–1954 had drawn down the water table over part of the ore body (Diamond Drill Hole 1 curve), but additional well points were necessary to increase the area of influence. The curve for diamond drill hole 4 (DDH 4) shows the relationship of the water table in the northern part of the ore body to pumping in rotary drill hole 15 (RDH 15). Note that RDH 16 has little drawdown effect on these two observation holes and is apparently operating in a separate aquifer system

TABLE I
RECORD OF UNDERGROUND PROBE HOLES

RDH NO.	DEPTH OF PROBE HOLE	MSL ELEV. OF PROBE HOLE	HEAD (psi)	INITIAL FLOW (gpm)	NO. OF TRIAL HOLES	TOTAL FOOTAGE DRILLED
3	1532	− 838	195	200*	5	106
7	1532	− 838	165	200*	13	437
8	1532	− 838	160	200*	4	98
9	1532	− 838	150	200*	4	70
11	1532	− 838	130	200*	16	372
14	1710	−1103	378	800	1	22
15	1676	−1054	686	700	2	48
16	1729	− 864	298	300	1	38

** Pump operating in well at time of tapping.*

permeability of 2×10^{-3} gpd/ft, and the feeder stream was diverted to a flume.

Drawdown Arrested 5000 Ft from Shaft

The data obtained from drawdown observations were analyzed by several methods for transmissibility and storage coefficients. Rigorous mathematical treatment was difficult because pumping rates were not constant, but the generalization can be made that the original transmissibility (Theis method) was probably 5000 gallons per day per foot. This number has been reduced by barrier type boundaries (probably faults) to 1/6 or 1/10 of the original value. Storage coefficients ranged from 2×10^{-3} to 27×10^{-3} after 1000 days of pumping.

Drawdown for 200, 600, and 780 days of pumping plotted against the logarithm of radius from Shaft A indicated an arrest in drawdown at a distance of about 5000 ft northwest of the shaft. The parallelness of contours on early piezometric maps, and faulting, later verified by closely spaced underground drilling, support the idea that the change in drawdown rate is due to a poorly permeable zone which inhibits the flow.

Wells Intercepted Underground

Frequent replacement of pumps in the rotary drill holes indicated the need for a more efficient method of ground water withdrawal. The plan adopted was to drift to the bottoms of selected holes and take the water underground to the main pump station, thus eliminating the submersible pumps.

At 1548 ft depth in B shaft, a permanent pump room was installed, with 5 by 7-ft interception drifts driven to within a short distance of the rotary holes. Deflections at depth in the rotary holes had been surveyed by standard oil field techniques that depended upon a compass needle for azimuth. These data were used to plot targets for drifter holes that were to take the first flows, then later were to be reamed to four in. diam. Submersible pumps were operated at the time the probe holes were drilled in order to reduce the head.

Inaccuracies of the magnetic survey, which were probably due to the proximity of the magnetic ore body, caused an excessive loss of time in trying to locate the wells (table I). After a number of unsuccessful drifter holes had been drilled toward RDH 7, an induction coil and portable voltmeter were used to measure the field from the 2300 volt cable in the probe holes. Peak voltages plotted along the probe holes indicated the correct distance and trend of the peaks indicated direction for succeeding trials. RDH 7 was tapped on the first trial after the induction coil survey. The same method was used to locate RDH's 3, 8, and 11 after a number of dry probe holes had been drilled. After several drifter holes had been drilled into the wells, the valves were opened and water impounded back of bulkheads located in the interception drift.

Five rotary holes around the shafts have been "unitized" through the 1548 ft pump room which has been operating since 1955. Submersible pumps have been removed and surface equipment cleared from the shaft area.

When mine development was carried into the ore area, it was decided to drift to the better producing wells that were drilled on the periphery of the ore body. The survey distances to these wells were considerably greater than to the shaft wells, which meant more chance for error with bearings, distances, and elevations. Locations of RDH's 14, 15, and 16 at the elevation of the first mine level were surveyed by the gyroscope technique with final results that were far more accurate than the first experience (table I).

Total rock excavation required to reach the rotary holes consisted of 3000 ft of 12 by 12-ft drift through quartzite, 500 ft of 6 by 6-ft drift in limestone, and 218 linear ft of 5 by 5-ft raise through quartzite on a 47° slope. The raise was necessary to reach the open part of RDH 16 which had originally been drilled to the first level elevation and later had been reamed to 24 in. diam. Unrecovered broken tools had blocked the 24 in. drilling 125 ft above the first level.

To obtain maximum yield from the well and eliminate well pumps, rotary drill hole No. 16 was intercepted with a drift at a depth of 1750 ft. The picture shows the bottom of the 20-in. casing string in the hole at the end of the drift

Four Independent Surveys Run

To guide the interception drifts to the desired proximity of the wells, four independent and accurate surveys were necessary: (1) Tape and transit loops were run between shaft reference points and the surface origin of the holes. (2) The shaft reference points were transferred 1812 ft vertically to the first level by the single-line method of plumbing. (3) Underground tape and transit loops were run independent of the routine surveying for mine development. These were carried from the shaft plugs to the face of each drift. Surveying in the raise toward RDH 16 was particularly difficult because of the slope angle and because a conglomerate bed near the midpoint yielded water at the rate of 400 gpm. (4) Deflections in the wells were surveyed by gyroscope to provide targets for the probe drilling.

Arrangements for probe drilling at the faces was somewhat different in each case as experience indicated time-saving improvements. A reinforced concrete plug at the face of RDH 14 drift held the probe hole casings.

The face of the drift for RDH 15 was gunited and the casings were anchored with clamps and five-ft rock bolts. In RDH 16 drift, bolted clamps were used to hold the casings in the untreated rock face.

Drills were aligned with a transit toward the calculated well locations and in two of the three cases, the wells were contacted with the first probe hole. At RDH 15 after the first probe failure, a second parallel hole was started one well diam (12 in.) north and made contact. The drilled distances for the three interceptions were as predicted from the gyroscopic survey.

Probe drilling was through 2½ in. gate valves which controlled the flows and aided rod extraction. There was little difficulty with extraction even though the head was as high as 1580 ft at the time of contact with RDH 15 and initial flows were as high as 700 gpm. Continued bleed-off through the probe holes has reduced the head in the wells to within less than 200 ft of the first level. Drawdown in RDH 16 became sufficiently low to permit a short drift to be driven into the bottom of the well casing. This hole now serves the auxiliary purpose of supplying 10,000 cfm of fresh air to the west end of the mine.

Mine Water Clarification Reduced Pump Wear

In order to provide a clear water feed to the main pumps, flows from the rotary drill hole drifts are piped directly to the main sumps on the third level. Other provisions for clear water feed were made by building a steel dam in a drift off the third level main haulage near the production area. Mine water from the first and second levels is transferred to this drift through six-in. diamond drill holes, allowed to settle, and decanted into an eight-in. line.

Water entering the silt drift has a suspended solids content up to 2000 ppm but when decanted is as low as 100 ppm. Cleanout is facilitated by the rapid opening of the dam, which permits direct access for an Eimco loader and dumpster cars. A similar arrangement with a removable door has been constructed at the bottom of A Shaft where spillage from the pockets had created a problem.

The clarification of mine water and direct feed of well water to the main pumps has reduced impeller wear and maintained pump efficiency.

Effect of Control Program

An example of the beneficial effect of the wells during shaft sinking was observed when the grouting plug was in Shaft A at 1022 ft depth. At that time the shaft was essentially a concrete cylinder that leaked slightly through construction joints and a few weep-holes. A pressure gage at 910 ft showed a water head of 100 ft against the lining. During a power shut-off that lasted seven hours the head on the gage increased rapidly to 30 ft, then more slowly to a maximum of 420 ft until pumping resumed.

Relief from water flow through rock was demonstrated when a four-ft section (1112 ft–1116 ft) was left exposed for a week while work was performed higher in the shaft. The shaft was taking 120 gpm until the pump in RDH 3 failed. Inflow immediately mounted to 190 gpm, and after four days had climbed to 240 gpm. A new pump in RDH 3 reduced the flow to 175 gpm then ultimately to 160 gpm

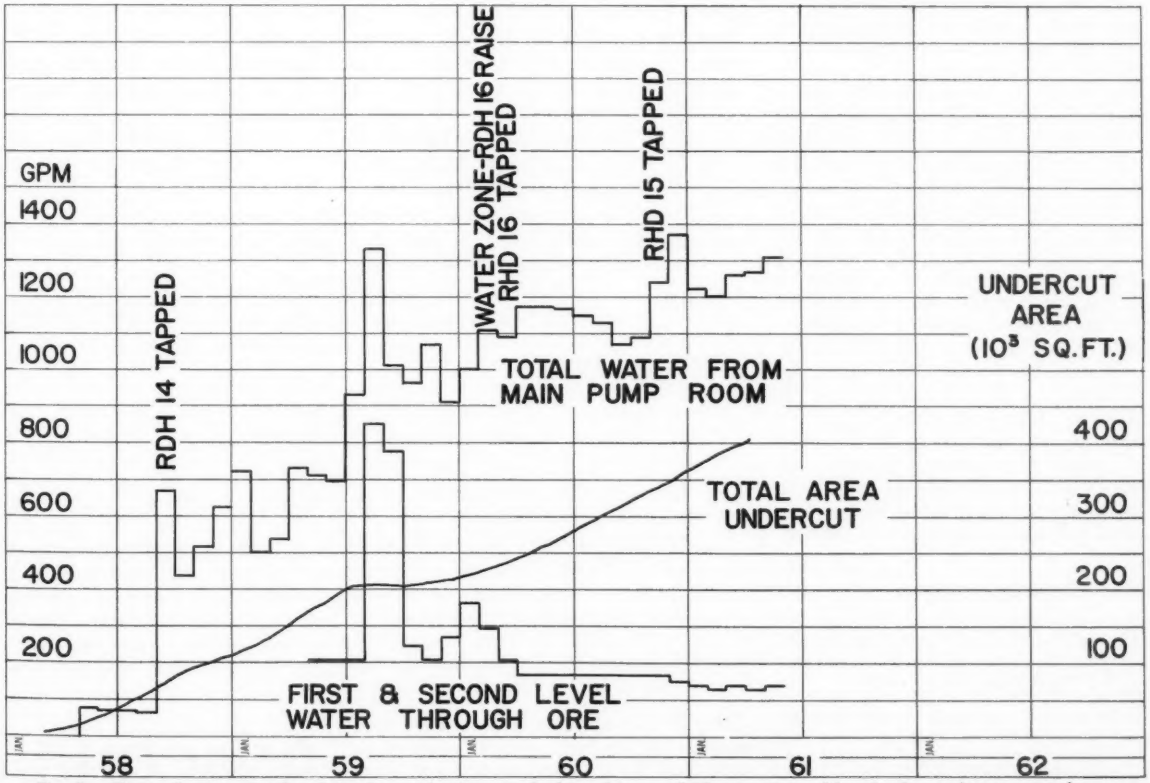


Fig. 3. Flows of water developed in the production panels have become fairly constant although the undercut area has expanded and caving is known to have progressed at least 200 ft into the hanging wall

when rock excavation proceeded.

The effect of ground water control in the ore area is shown by the relationship of total water pumped to water coming through the ore. In figure 3 the plotted data is: Monthly average pumping rate of the main pump room which includes all RDH water, average monthly flow of mine water, and the size of the undercut area. The peak mine flows of August and September 1959 can be interpreted only as a sudden breakthrough due to the working of caving ground since there was no development during the period of July to November.

Mine water continued to increase until February 1960, when the raise to RDH 16 cut a water-bearing conglomerate bed that yielded about 400 gpm and caused a noticeable drop in first level mine water. Along with the water production from RDH 16 in March 1960, mine water flows reduced even further. Since that time mine water has remained fairly constant even though undercutting and production have expanded.

Main Objectives Achieved

The deep well program has succeeded thus far in two main objectives: (1) It has materially helped the shaft sinking through broken and permeable ground, and (2) water coming through the ore has been reduced and maintained at a relatively low flow. Secondary benefits have been the flow of fresh air with the water in RDH 16, and the supply of clear make-up water for the concentrator and pellet plant.

In the future, it is quite likely that the overlying sediments will be disturbed all the way to the surface as the ore is extracted from a number of levels. Such action may cause some of the water now being carried by RDH 14-15-16 to appear in the mining area, but a substantial portion of this water will probably continue to flow as at present. If flows through the ore do increase, with the deep drawdown and storage depletion already achieved, it is believed that the hazard of a major flood in the cave area has been minimized or averted.

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MINE-POWER

by Steve Bunish

whose many years of practical experience underground followed by developmental work at Anaconda has made him a recognized authority on mining cables.

Steve Bunish answers your questions on mine cable application and maintenance.

#2: hardening and cracking of cable jackets

Dear Steve,

We have been losing some cable because the jacket becomes hard and brittle. Then cracks develop and we have to replace the cable. Any idea of what may be causing these cracks? And is there anything we can do to prevent this kind of failure?

L.F.P., Pennsylvania

Dear L.F.P.,

Brittle, cracked or crazed jackets indicates a heat problem. When cable insulation and jackets are overheated for long periods of time they tend to grow hard and brittle, and crack when they ought to bend. There are several causes for cable overheating:

1. The conductor is too small, or;
2. Operating voltage is too low, or;
3. Cable length is excessive, or;
4. Overload protection is inadequate or non-operating, or;
5. Cable rating has not been decreased even though there are several layers on the cable reel.

Current rating for cable is based on one cable in air, with nothing near it to prevent removal of heat by the air. When cable is wound on a reel, natural ventilation is no longer sufficient, and the current rating **goes down,** like this:

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Two layers	.65 of specified value
Three layers	.45 of specified value
Four layers	.35 of specified value

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1. When you're working near the power source, remove excess cable from the reel to make sure it gets plenty of ventilation;
2. Reverse the ends of the cable periodically, so that the same section is not always exposed to the high temperature normally found near the reel. A good time to do this is when you remove the cable for permanent repairs. Mark the cable ends, and you'll always know which was which.

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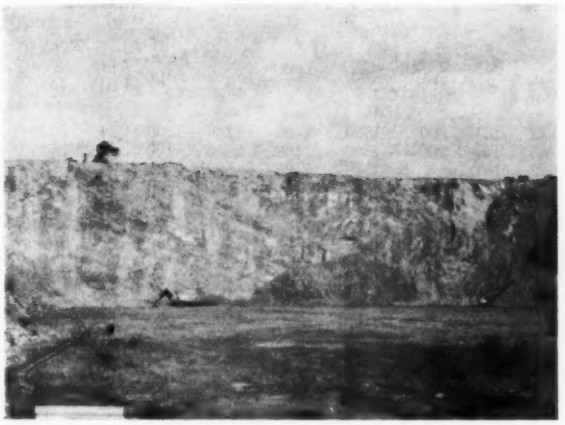
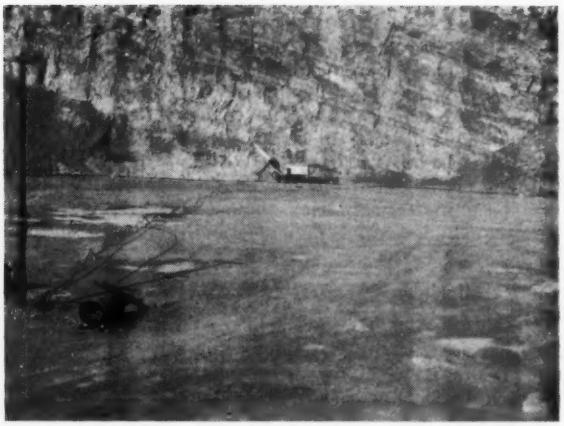




Views of the Union Furnace quarry, where Warner Co. breaks a full year's supply of limestone with a single blast. Using 30-ft spacing and 30-ft burden, all blast holes are over-drilled by 10 to 15 ft

Control of a Large Blast to Tonnage Requirements

By H. A. CORRE
Plant Manager
Bellefonte Division
Warner Co.

A 13-hole shot at Union Furnace quarry broke an estimated 190,000 tons of stone with good fragmentation

AT the Union Furnace quarry of the Warner Company, located near Tyrone, Pa., it has long been the practice to blast sufficient stone once each year to meet requirements during the operating season, which is generally from April to November. The amount of stone to be shot down is determined from estimated sales forecast and the amount of processed stone in inventory from the previous year.

This practice of blasting once a year has eliminated the necessity of removing track and equipment during the operating season when demands for stone are the greatest. It also aids in scheduling the operation of the plant on a more efficient basis with minimum manpower.

The quarry at Union Furnace is approximately 990 ft long and 185 to 195 ft high. The limestone is in the Trenton series. It is siliceous in nature, and is used for aggregate business.

Hole Spacing and Burden on 30 by 30 Ft Pattern

In order to improve drilling efficiency and to concentrate the loading in one section of the quarry and to restrict the number of holes to be shot, the pattern of drilling has been changed from an 18-ft burden and 18-ft spacing, using six-in. drill holes, to the present pattern of 30-ft burden by 30-ft spacing pattern, using nine-in. drill holes. The base or primary charge of explosives has consisted of ammonia gelatins and semi-gelatin dynamites. For the past two years, ammonium nitrate based nitro-carbo-nitrate materials have been used as top charges of blasting agents as con-

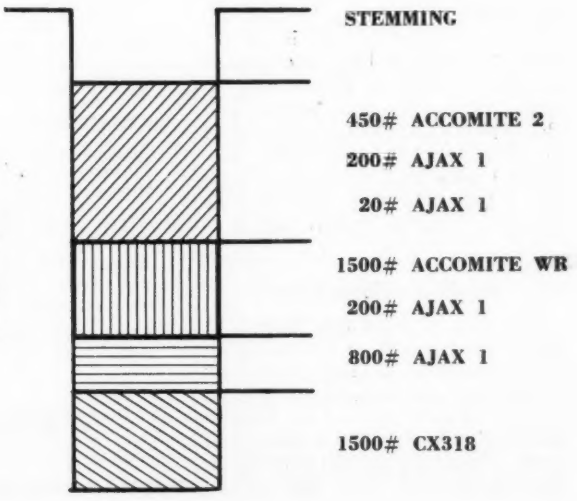


Fig. 1 Typical loading in a blast hole at Union Furnace quarry. Ajax 1 is used as a primer for the blasting agents and is intermixed throughout the column for this purpose

ditions permitted. Excessive water conditions are encountered and require tubular packaged water-resistant blasting agents. The dry borehole areas are charged with bulk plant compounded blasting agents. The 30-ft burden has proved very successful in that production from the quarry has been increased during the past two years by improved fragmentation.

All Holes Over-Drilled

In all cases the holes are drilled 10 to 15 ft below the quarry floor using a conventional churn drill. This overdrilling takes care of any filling of the hole by water, and silt or mud seepage, and still leaves the holes below the quarry floor.

Recently 13 nine-in. holes, on 30-ft spacing with 30 ft of burden, were shot, breaking an estimated 190,000 tons of stone with 59,250 lb of explosives.

The breakdown of the explosives used is shown below:

WEIGHT	EXPLOSIVE
A. 500	75% Standard Gelatin
B. 19,500	CX318—Ammonia Gelatin Dynamite
C. 13,000	Ajax 1—Semi-Gelatinous Dynamite
D. 20,000	Accomite WR-1
E. 6,000	Accomite 2 Bulk
F. 250	Ajax 1 2 × 8 Side Primers

Explosives A-B-C were in single tubular containers, with tape lowering loops and tapered nose. Explosives D was a plant compounded blasting agent, water resistant, in spiral wrapped shell with tape lowering loops and tapered nose, and explosives E was a plant compounded bulk blasting agent.

Figure 1 shows the loading in a typical hole.

Figure 2 gives the details of the shot, with depth of holes and amount of various blasting agents used in them. Wire countered plastic and plastic reinforced Primacord was used in all holes. The Ajax (SP) side primers were used for sliding down the Primacord; thus keeping the primer in intimate contact with it.

Handling a Blocked Hole

It should be noted that Hole #11 was blocked in drilling and only 45-ft was available for loading. Therefore, an attempt was made to concentrate charges on both sides of the blocked hole to abet fragmentation and to pull in the area of the blocked hole. To do this, opener Hole #13 was opened towards the center of the quarry and, with Holes #12, 11 and 10, detonated instantaneously with a Primacord trunkline to aid in attaining the proper fragmentation in the area of the blocked hole.

Holes #9 thru Hole #1, which was the corner hole, were detonated with parallel Primacord trunklines, with cross-ties at each hole, using 34-millisecond delay between holes. This was accomplished with two jointed 17-millisecond connectors in parallel for all delayed holes. This was an approach to obtain an approximate one millisecond delay per foot of bore hole spacing. The initiation of the Primacord was obtained by using two electric blasting caps.

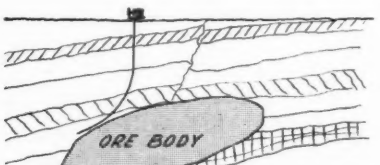
The spread of stone was quite uniform, with excellent breakage. Maximum distance stone was thrown from the face of the quarry was about 250 ft.

Hole No.	Drilled Depth	Actual Depth	Water	Face Height	75% Std. Gal.	CX 318	Ajax 1	Accomite WR	Accomite 2	Ajax 1 SP	Total Explosives
1	220	180	12	184	300	1500	1100	200	1900	20	5020
2	220	207	65	184	200	1500	1100	2250	100	20	5170
3	210	203	23	184		1500	1100	600	2200	20	5420
4	210	192	32	184		1500	1100	1600	600	20	4820
5	210	206	69	184		1500	1100	2300		20	4920
6	210	185	61	182		1500	1100	1900		20	4520
7	210	190	40	182		1500	1100	1900	100	20	4620
8	210	195	64	182		1600	1100	2000		20	4720
9	210	197	42	182		1700	1000	2000	100	20	4820
10	210	188	60	182		2000	1000	1700	150	20	4870
11	210	48		182			200	100	500	10	810
12	210	194	47	180		2000	1000	1850		20	4870
13	210	193	37	180		1700	1000	1600	350	20	4670
					500	19,500	13,000	20,000	6,000	250	59,250

Fig. 2. Details of holes and loading at Union Furnace, March 15, 1961

ARE DEFLECTING DRILL HOLES
BY-PASSING ADDITIONAL RESERVES?

A mining company in the Eastern United States started a drilling program looking for new reserves. Several thousand feet of drilling developed no new reserves.



PROBLEM:
Were the drill holes "bottoming" where they were planned? There was a strong belief that the holes were "Off-Course".

SOLUTION:
Sprague & Henwood's Contract Division was engaged to do some additional drilling with special attention to be placed on controlling the "dip" and "drift" of the holes.

To do this S&H used the most modern hole surveying techniques and equipment to check deflection as the drilling progressed. This, coupled with modern drilling equipment, experienced crews, and expert supervision resulted in uncovering reserves that extended the probable life of the mine 20 years.

Contact the Sprague & Henwood office nearest you for information relative to your core drilling problems.

SPRAGUE & HENWOOD, Inc. S&H
SCRANTON 2, PA.
New York • Philadelphia • Nashville • Pittsburgh • Salt Lake City • Tucson • Buchans, Nfld.

Here is a powerful management tool that may be used to cut costs and increase the return from investment capital

Profitable control of production and transportation through operations research

By David B. Hertz
and
Norman O. Olson
Partners, Arthur Anderson & Co.

OPERATIONS research may be used to improve the efficiency and profits of mining companies. The opportunities of coal producers have been greatly expanded by new ideas in the field of production technology. The opportunities will be enhanced if new ideas and techniques in the area of planning and management controls continue to be pursued with equal vigor.

Planning and Controls are Important

The mining industry is making a sound comeback from the loss of important markets to competitive fuels. Authorities feel that the demand for coal will now increase due to the growth of electric utilities, increased steel production, further improvements in mining and transportation technology, the abundance of reserves, and the development of new uses for coal.

A major concern of the mining industry centers on maintaining and strengthening the competitive position of coal in the economy. The companies in the industry must maintain or improve the price relationship of coal with other fuels through efficient production and transportation, well planned and administered capital investment, and sound sales agreements. These needs require strong control over operating and transportation costs through sound planning and effective utilization of accounting and statistical information.

Following are some illustrations of areas where sound planning and good information are an essential ingredient for success:

1. **A major amount of coal is sold under relatively long-term sales agreements, and success here depends on careful planning when the sales arrangements are made. Sales agreements involve complex factors of long-term investment, transportation, quality specifications, etc. A company's profits may be fixed at a desirable or undesirable level for a relatively long period of time by the terms of such agreements.**
2. **In the area of production, management is continuously faced with many alternatives with respect to size and type of equipment, placement of equipment, and opening new fields or closing old fields. There is a real place here for establishing standards of performance under given sets of mining conditions, varying with terrain, overburden, seam size, etc., and to measure actual costs accordingly. Information of this kind can be very important in making decisions on mining alternatives, as well as for supervising operations.**
3. **Coal mining companies encounter a number of special tax problems. Among the more important areas involved are (a) depletion, (b) development costs, and (c) royalty income and expense. Proper tax planning must be correlated with operations planning if income taxes are to be minimized.**
4. **In any company with several mines, the proper allocation of orders and production among mines is important, and becomes extremely complex. Minimizing total operating and transportation costs through proper sales order allocation procedures can be most effectively accomplished through certain mathematical techniques. It is in this area that we want to concentrate our remarks to demonstrate one example of the utilization of operations research techniques in the coal industry.**

Planning in each area usually affects every other area. For example, obtaining maximum benefits from the proper allocation of sales orders depends on effective planning of sales agreements and requires consideration of the effects on statutory depletion.

Volume, gross profit margins, inventory turnover, working capital ratios, and the like are common and valuable yardsticks used in measuring the performance of men, machines, and products. In the final analysis, however, coal mining operations must be evaluated in terms of the return generated on the capital invested in coal reserves, equipment and facilities.

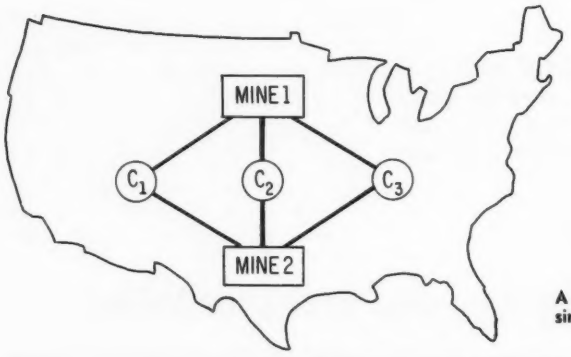
What Is Operations Research?

Operating executives face many problems requiring decisions—many on a daily basis. To make these decisions effectively, requires information regarding the factors involved in each problem. The resolution of a number of factors affecting individual problems in order to make decisions is the essence of management in every industry.

Operations research can assist operating executives by developing systematic means to assemble logically related facts so that the opportunity will exist to make better decisions. Operations research cannot replace business judgment—it can only establish the useful facts in a logical manner.

Areas in which all business managements require information and in which operations research has demonstrated an ability to help include—

1. **Long-range Forecasting — Every business must look to the future. The businessman bases his decisions**



MATRIX OF COSTS AND REQUIREMENTS

MINE NO.		CUSTOMER NO. 1	2	3	MINE CAPACITY
1	VAR. PDN. COST	$2.50	$2.50	$2.50	
	TRANSPORT. COST	3.50	3.00	3.40	4,500
	TOTAL	$6.00	$5.50	$5.90	
2	VAR. PDN. COST	$2.00	$2.00	$2.00	
	TRANSPORT. COST	2.50	2.25	2.90	3,000
	TOTAL	$4.50	$4.25	$4.90	
CUSTOMER DEMAND		2,200	1,800	3,500	7,500

MINIMUM-COST SOLUTION

	CUSTOMER NO. 1	2	3
SHIPMENTS	0	1000	3500
SHIPMENTS	2200	800	0

MINIMUM COST: $39,450

A company with two mines serving three customers has a relatively simple task in allocating shipment. No special mathematical or analytical techniques are required to solve the problem

as to replacement policies, expansion, product development, and research, at least in part, upon the long-range forecast. Forecasts are uncertain by nature. The explicit nature and impact of the uncertainties can be revealed by the systematic procedures of Operations Research.

2. **Short-range Forecasting—Almost all everyday operations in business require some short-term forecasting. The methods used may be "top of the head" or "seat of the pants," Nevertheless, you use them to decide daily on such matters as where and how much to ship or mine, how many of what spare parts to purchase, determining personnel requirements, and the like. Operations research has been helpful in providing information to assist in making judgments in the face of short-term uncertainties.**

3. **Matching Equipment Capacities — Determining the costs of bottlenecks and pointing out the opportunities for savings by changes in capacities at various production points are problems on which operations research can be of assistance. As an example this problem may be encountered in obtaining the best matching of loading, hauling and preparation equipment capacities.**

4. **Minimizing the Cost of Product Ingredients—Determining the proper combination of ingredients to meet quality or other standards at the lowest total cost in the face of constantly changing ingredient prices is a difficult problem in many industries such as the steel and petroleum industries. Operations research techniques have been of dramatic help on this kind of problem.**

5. **Transportation Problems — How to redistribute surplus freight cars at certain locations so as to meet shortages elsewhere and at the same time minimize the cost of hauling empty cars is an example of a transportation problem to which operations research techniques can be adapted. This problem requires no special techniques if we are talking only about four cities and four freight cars, but does require special techniques if there are numerous cars and locations.**

Linear Programming Helps Solve Shipping Problems

Linear programming is one of the new tools of mathematical analysis for decision-making which has been developed in the last ten years. It is one of the more important of operations research techniques.

Linear programming might be described as an analytical method of finding, from a large number of possible combinations (such as matching mines and customers), the best combination to achieve a given objective, such as maximizing profit. The great advantage of linear programming is that it is a very efficient shortcut in mathematical calculation which makes it possible to solve in a few hours a problem that, if conventional means of calculation were used, would require an impossibly long time.

If one had to solve a problem involving three origins and five destinations with a total of 20 cars to redistribute, the answer to the problem cited earlier would not be so obvious. If one were to list and evaluate all feasible solutions to this relatively simple problem, the number of solutions to be considered would be in the order of ten million. Linear programming can provide the solution in not more than six or seven steps. In a problem involving 50 to 100 origins and destinations, and several thousand freight cars, the number of possible solutions would be beyond counting, and the linear programming solution would only be possible if one used a high-speed electronic computer. Fortunately, standard solutions to these problems have been programmed for most of the standard computers in use, and with such a program the computation time is cut to a very short period.

One of the important general types of linear programming problems is the transportation and allocation problem. In essence, this kind of problem involves the movement of limited quantities of a single product from a group of origins to a group of destinations. Management may have one of several objectives: To minimize the total distance traveled, to maximize total profit, to minimize the total time involved, or to minimize the total cost.

A company's operating results may be affected significantly by the way sales orders are distributed among alternative mines. In a company with several mines, the allocation of sales orders among mines and transportation facilities, together with effective production scheduling, is a major problem if costs are to be minimized. The problem lends itself to the application of linear programming techniques.

The objective may be stated as follows: To distribute customer orders among mines in such a way as to minimize the total mine operating and transportation costs. This includes consideration of percentage depletion which is a deduction taken for income tax purposes which is based on a percentage of sales of a mine, but is limited to a certain percentage of its net profits. The same information once logically organized can be useful in other specific ways, such as in negotiating a new sales agreement, in establishing a new transportation arrangement, or in choosing a new mine location.

The solution of this problem—allocating shipments in such a way as to minimize total costs—requires consideration of a number of factors. These include: 1. Cost differences among mines. 2. Cost differences among alternative transportation facilities. 3. Mine locations and transportation differentials. 4. Individual mine operating capacities and reserves. 5. Quality specifications and restrictions spelled out in sales agree-

ments. 6. Percentage depletion allowances.

This case describes the operating, or "out-of-pocket," costs of mining and transportation, and not the capital investment in mines, since these costs have already been expended. It is desirable to incur as small an amount of costs on top of capital investment as possible to make satisfactory delivery of coal to customers.

Let's start with an uncomplicated situation where there are two mines and only three customers (destinations). Also assume that the requirements of the customers are exactly equal to the operating capacities of the mines.

The accompanying diagram is relatively simple, and the accompanying solution is fairly obvious and required no special mathematical or analytical techniques. It should be noted here that the only cost which can be affected by the allocation is transportation, since the two mines are operating exactly at capacity.

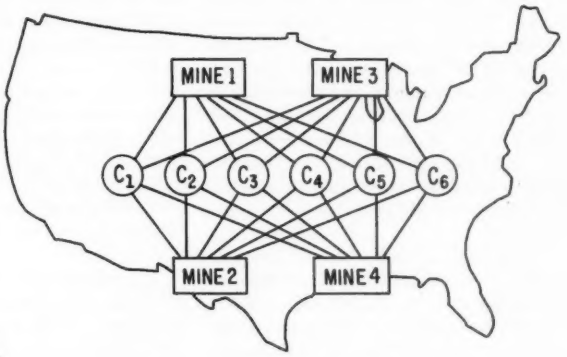
Add two mines and three customers and assume that some excess capacity exists.

The diagram is considerably more complicated than the preceding one, and the number of possible combinations has increased tremendously. Some of the possible combinations can be ruled out by inspection, but to arrive at the "least cost" combination is no longer obvious. The solution is already complicated to the point where special analytical techniques are essential if the least cost solution is obtained. Experienced management, of course, can arrive at reasonably good answers, but the differences between such answers and one which is arrived at by linear programming techniques may have a significant impact on net profits.

The accompanying chart shows the solution—an aggregate cost of mining and transportation of $63,570. Under the assumptions given, no other shipping program would achieve a smaller cost. Judgment of other factors may lead to other allocations, but with this information the cost consequences of these decisions may be evaluated.

Basically, linear programming is a systematic and highly efficient trial and error method, which provides a sure-fire test for recognizing the least cost allocation. The method takes ad-

Allocation of mine production from four coal mines serving six customers requires special analytical techniques if the least cost solution to a given problem is to be achieved



Matrix of Delivered Costs and Requirements

MINE NO.	MINE VAR. PROD. COST	CUSTOMER NO. 1	2	3	4	5	6	(EXCESS CAP.) 7	MINE CAPACITY
1	$2.50	$6.00	$5.50	$5.90	$6.50	$7.00	$7.50	0	4,500
2	$2.00	$4.50	$4.25	$4.90	$5.15	$5.50	$5.80	0	3,000
3	$2.25	$8.25	$7.75	$5.35	$5.15	$4.95	$4.75	0	4,000
4	$3.00	$5.90	$5.60	$6.00	$5.70	$5.40	$5.65	0	2,000
CUSTOMER DEMAND		2,200	1,800	3,500	1,500	2,400	900	1,200	13,500

Minimum – Cost Shipping Program

MINE NO.	CUSTOMER NO. 1	2	3	4	5	6	(EXCESS CAP.) 7	MINE CAPACITY
1	–	1,000	2,300	–	–	–	1,200	4,500
2	2,200	800	–	–	–	–	–	3,000
3	–	–	1,200	1,500	400	900	–	4,000
4	–	–	–	–	2,000	–	–	2,000
DEMAND	2,200	1,800	3,500	1,500	2,400	900	1,200	13,500

MINIMUM COST: $63,570

Freight Rate from Mine 1 to Customer 3 Reduced by 30¢ (Approx. 5%)

MINIMUM – COST SHIPPING PROGRAM

MINE NO.	CUSTOMER NO. 1	2	3	4	5	6	(EXCESS CAP.) 7	MINE CAPACITY
1	–	1,000	3,500	–	–	–	–	4,500
2	2,200	800	–	–	–	–	–	3,000
3	–	–	–	1,500	1,600	900	–	4,000
4	–	–	–	–	800	–	1,200	2,000
DEMAND	2,200	1,800	3,500	1,500	2,400	900	1,200	13,500

Minimum Cost Before Rate Reduction	63,570	Reduced Cost, No Change in Shipping Program	690
Minimum Cost After Rate Reduction	62,640	Reduced Cost, After Reallocation	240
COST SAVING TO SHIPPER	930	COST SAVING TO SHIPPER	930

INCREASED REVENUES TO CARRIER: REDUCING RATE $6,030

Added Restriction: Customer 3 Served Only by Mine 3

MINIMUM – COST SHIPPING PROGRAM

MINE NO.	CUSTOMER NO. 1	2	3	4	5	6	(EXCESS CAP.) 7	MINE CAPACITY
1	–	1,800	–	1,500	–	–	1,200	4,500
2	2,200	–	–	–	800	–	–	3,000
3	–	–	3,500	–	–	500	–	4,000
4	–	–	–	–	1,600	400	–	2,000
DEMAND	2,200	1,800	3,500	1,500	2,400	900	1,200	13,500

Minimum Cost, This Program	$65,950	Customers 2, 4, 5, 6	+$3,645
Minimum Cost, Before New Restriction	63,570	Customer 3	– 1,265
COST OF RESTRICTION	$ 2,380	COST OF RESTRICTION	$2,380

vantage of the not-so-obvious but, nevertheless, demonstrable fact that the maximum number of routes (mine—customer pairs) which need to be used in order to obtain the lowest cost is one less than the sum of the number of mines and customers. (Note that, in the two mine and three customer examples, four routes were used; in the four by seven example—in which excess capacity was counted as the seventh "customer"—ten routes were used.) The first step in the linear programming technique consists of selecting one possible shipping program which meets the basic requirements of customer demands and mine capacities—and which contains no more than the required number of routes. This allocation of customers to mines is called the first feasible program. The technique then provides a quick way of determining which, if any, substitution of an excluded route for a route included in the first feasible program will decrease costs. One such substitution is made, and a new, lower cost shipping program is obtained. The process is repeated until no further cost-saving substitutions can be made. At this stage, the minimum-cost shipping program has been determined.

Assuming the same set of facts as in the preceding illustration but introducing a factor involving a specification or restriction in one of the sales agreements, may provide a completely different allocation. Ordinarily such a solution will involve a higher total cost than one where there are no restrictions—emphasizing the fact that specifications or restrictions represent a cost.

Assume that the sales agreement specifications (BTU content, for example) of Customer No. 3 are such that all of his coal must come from Mine No. 3.

The accompanying solution shows that the cost of this restriction (shipping Customer No. 3 only from Mine No. 3) is $2380.—the difference between this and the preceding solution. The total cost increases, despite the shift in supply, for 2300 tons of Customer No. 3's requirements, from Mine No. 1 (with a delivered cost per unit to Customer No. 3 of $5.90) to Mine No. 3 (with the corresponding cost of $5.35). This dramatizes the point that linear programming techniques may be useful in planning and negotiating new sales agreements since the costs of various specifications or restrictions can be projected. It is then possible to assess alternatives intelligently—such as, could modifications be made in customer equipment which would reduce the cost of coal and yet not add greater costs in burning.

It is also possible to measure the costs of meeting any customer's entire demand, some portion thereof, or any anticipated increases in his requirements by re-solving the problem with the appropriate change in the number which represents that customer's demand.

Assume the same set of facts with no sales agreement restrictions, but with a decrease in the transportation rates between one of the mines and one of the destinations.

If no reallocations were made in the shipping program, the total effect on cost would be a reduction in total cost of $690. However, the change in rates between these two points has resulted in a completely new solution to our problem. Using the new transportation rate between this mine and this customer, a linear programming analysis shows a least cost solution of $62,640, or a total reduction of $930. The carrier reducing the rate will receive 1200 tons of additional traffic between mine 1 and customer 3, amounting to a revenue increase of $6030. Some of the other carriers lose business because of the rate reduction.

This illustrates another useful "sensitivity" type of analysis which may be made with linear programming techniques. To be able to make speedy recomputations in the face of a change in transportation rates and to project the total cost consequences of such a change may be of very great value in deliberations with carriers.

Summary and Conclusions

The techniques of operations research and how one of its techniques, linear programming, can be adapted to one of the many problems in coal companies, has been outlined. The examples have probably been considerably less complicated than those which most companies face. That many additional complications exist—more mines, market diversification, more customer restrictions, the position of reserves, dedication of mines to particular plants or customers—merely emphasizes the need to these kinds of techniques if costs are to be effectively controlled.

These are practical techniques applicable to problems which face most companies regardless of size, and they are by no means "Cloud 9" in their approach. Consider whether the information upon which decisions are made (and the manner in which it is organized) is adequate to face the challenge of competition, and to realize the great economic potentials which exist for coal producing companies, their customers, and their suppliers. The techniques of Operations Research would appear to afford excellent assistance in more fully accomplishing these objectives.

(Author's note: In view of the rather technical nature of the subject which was briefly discussed above, an Appendix has been prepared which describes in more detail the methods employed in solving certain of the examples related herein. Copies of this Appendix may be obtained upon request to the *Mining Congress Journal*, Ring Building, Washington 6, D. C.)

"I don't have a dime—but I have the coffee!"

By W. F. Loranger
Manager, Chemical Process Sales
and
R. G. Edholm
Manager, Product Planning
General Electric X-Ray

Application of X-Ray Emmission to On-Line Control

On-line analysis provides the operator with continuous analytical data, furnishing immediate information needed to correct the mill operation in a suitable direction

X-RAY emission can be described as the analysis of materials (both qualitatively and quantitatively) by elements present, unlike x-ray diffraction, which generally refers to the analysis of materials by compounds present. There are a number of excellent references to which one can refer for a detailed description of theory and techniques involved.[1]

The transition from x-ray laboratory control to x-ray "on-line" control is of growing importance to industry today, particularly in view of the rapid progress in computer technology. Data loggers and computers are capable of storing and assimilating much information which can be used, with short time constants, as a basis to control process lines. Of utmost importance is the concurrent development of many types of primary sensors. One such primary sensor is the x-ray emission gage (XEG).

Materials for elemental analysis may be just as successfully analyzed by x-rays as they move continuously in a process stream or flow as they are in a laboratory on a "batch" basis. One important consideration, however, is that readout time for on-line control is generally an order of magnitude shorter than for laboratory control, which then becomes a dominant factor in instrumentation design.

Components of X-Ray Emission Gage

The x-ray emission gage is a device designed for the simultaneous quantitative measurement of up to six different elements in a given material. The range of elements is generally from atomic numbers 13 to 92 (aluminum to uranium). In some special cases it may be possible to measure magnesium, atomic number 12. The XEG is composed of a sensing head, sample presenter, detection electronic, and read-out devices (figure 1).

Sensing Head. Contained in the sensing head are the x-ray tube, x-ray optics, primary detectors (counter tubes) and preamplifiers. Arrangement of the x-ray optics is such that radiation from all (up to six) elements of interest in the sample can be detected simultaneously. Each optics path is referred to as a "measuring channel." The head may be used in a helium atmosphere, a necessary requirement when measuring light elements (magnesium through calcium). Vacuum operation does not appear practical or feasible for on-line applications at the present time.

Sample Presenter. The sample presenter and manner of presentation of the sample continuously to the sensing head depends upon the form the bulk material characteristically takes in a particular situation. Presenters are available for use with dry, finely divided solid materials, or with slurries or liquids. Since sample presenters must often incorporate a "window" between the sample and the sensing head, presenters are usually designed or modified for a specific process.

Detection Electronics. A separate, dustproof cabinet houses the detection electronics as well as the power supply for the x-ray tube. General

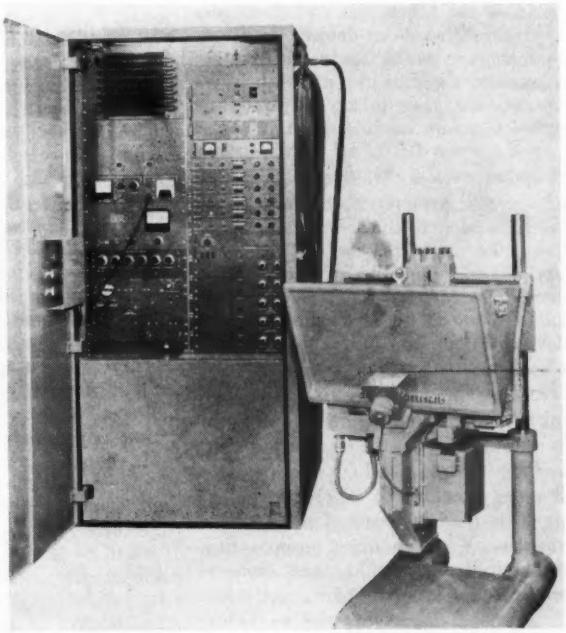
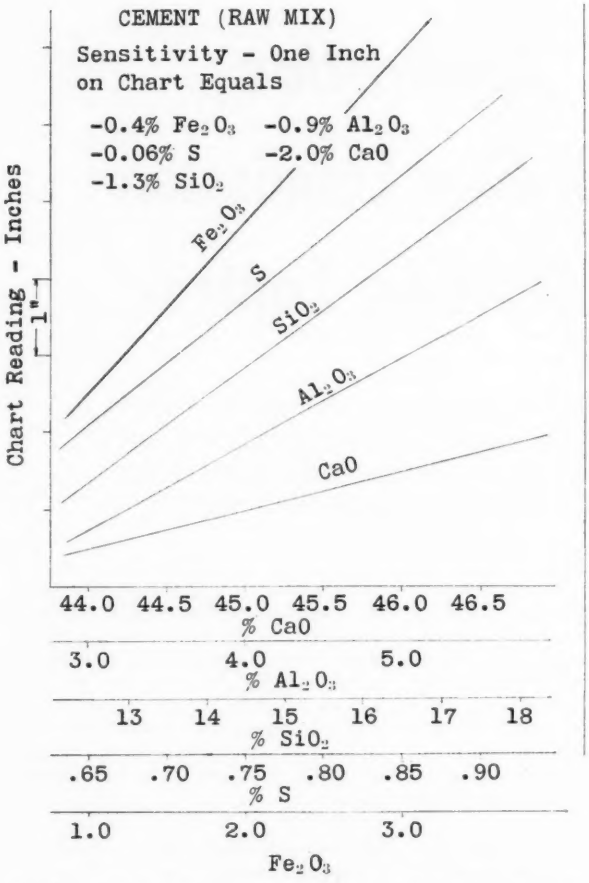


Fig. 1. The X-ray emission gage can give simultaneous quantitative measurements of up to six different elements in a given material. Shown here is an X-ray emission gage control cabinet and gage head with dry sample presenter



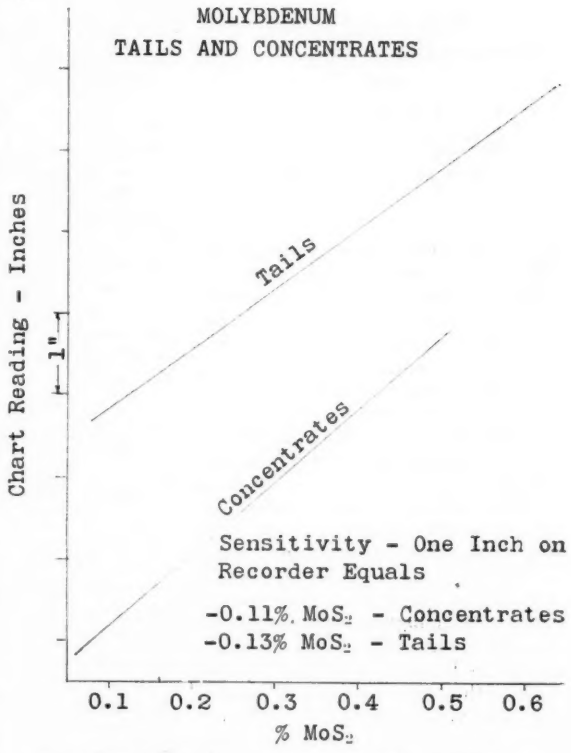


Fig. 2. (left) Cement raw mix feed calibration curves. Fig. 3. (above). Copper mill tailings (30–35 percent solids) at a concentration level of 0.35 percent MoS_2 were, in one instance, monitored with an analytical precision of plus or minus 0.05 percent (absolute) or better

function of the detection electronics is to receive the signal from the sensing head, translate it into useful information, based on calibration, and transmit the signal (in volts) to an appropriate read-out device. Of great importance is the inclusion of an automatic standardizer circuit which permits the gage to always function in reference to an initial calibration.

Read-out devices. These are a matter of operator preference, and may take the form of strip chart recorders, data loggers, computers, etc. As the output signal from the electronic circuitry (ratemeters) increases or decreases, and as noted on the read-out device, the amount of the element has correspondingly increased or decreased. The variation in output is initially calibrated from material with known amounts of the element present and similar to that which is to be continuously analyzed. Thereafter, the signal is read in terms of the desired quantity. With a moving sample, the signal indicates the average amount present over a period of time. By increasing or decreasing the response time of the circuitry, it is possible to measure variations which are either long term trends or short term variations in composition.

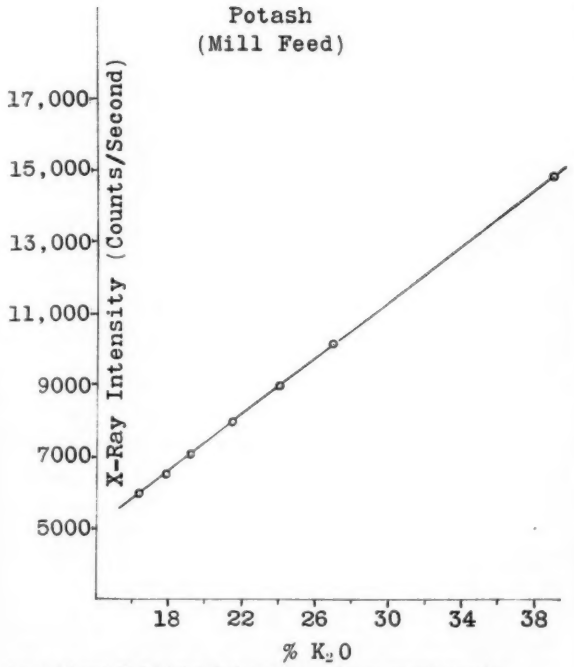
Sample Preparation and Presentation

In many cases it is possible to cut a sample from a main process stream and examine this directly with little or no further preparation. A good example of this is in the cement industry in which the dry, raw mix stream can be sampled and conveyed directly to the sample presenter and XEG. Another example is the analysis of tailings from a flotation process, although the manner of presentation of these two, a dry powder and a slurry, would differ greatly.

There are cases where peripheral sample preparation equipment might be necessary to satisfy sample specification requirements, such as dryers, mills, etc. Of critical importance in sample preparation, when peripheral equipment is considered, is transport time through the preparation system. It must be short enough to be compatible with on-line analysis objectives. An example would be in ore classification at the mine, at which point the material to be analyzed is of too large a particle size for direct presentation to the x-ray sensor. In this case, a representative portion may be cut, and then ground to specification for analysis.

The XEG dry sample presenter requires a minimum of 200 mesh material, but requirements vary with, and depend upon, the elemental analysis desired. Generally, particle size difficulties are not encountered as often when the bulk material is in the form of a slurry, as the solids are usually fine enough to insure adequate representation of sample measurement by x-rays.

In one case of analyzing a tailing directly by x-rays for copper content, it was reported that it was necessary to monitor by absorption gage technique the variations in density (or solid-to-liquid ratio) encountered in the stream in order to make suitable corrections. It is interesting to note that on-line experience with the XEG for a tailing analysis has shown that such corrections can be made using information obtained with the x-ray gage, without recourse to additional density measuring devices.



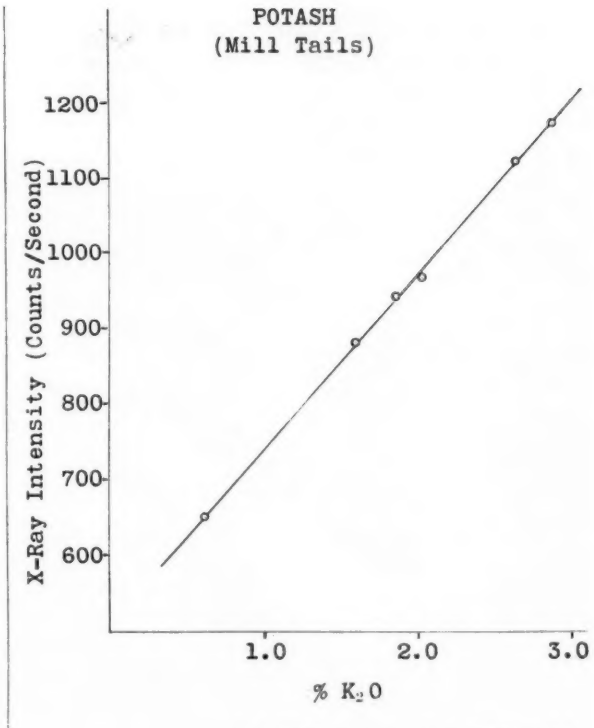


Fig. 4 (above) & 5 (right). Laboratory results on potash samples indicate a high feasibility for on-line control of mill tails, mill feed and concentrates. Results with fine grinding, as compared to "normal" grinding, gave better precision but not significantly enough to warrant additional grinding for on-line analysis

Kiln Feed Among Materials Analyzed

Although not strictly a mining application, one of the more successful uses of the XEG to date has been the analysis of dry, raw mix kiln feed in the cement industry. Three such installations are now in operation.

One company presented a paper at the General Technical Meeting of the Portland Cement Association in September outlining their use of the XEG as a chemical analyzer and on-line control device. The on-line analyzer is capable of continuous chemical analysis of the raw mix in the process stream with precision and accuracy limits comparable to those that can be obtained in the chemical laboratory. Instead of an analysis for calcium content every one to two hours, and a composite analysis on calcium, silicon, aluminum and iron every 24 hours, such analytical information is continuously available by referring x-ray read-out to the appropriate calibration. Trends can be readily recognized and feeder weight controls changed accordingly in the raw material area (figure 2).

Copper and Molybdenum Monitored

Of interest to the mining industry is the experience gained with an XEG used to monitor copper in tailings at a concentration level of 0.1 percent with a precision of better than ± 0.01 percent. An XEG was then installed to monitor molybdenum in the mill tailings. In a range of solids between 30–35 percent, at a concentration level of 0.35 percent MoS_2, the analytical precision is ± 0.05 percent (absolute) or better (figure 3). The obvious importance of such on-line analysis, other than for quality control, is the economic importance to the operator of having continuous analytical data which provides the immediate information necessary to correct the mill operation in a suitable direction.

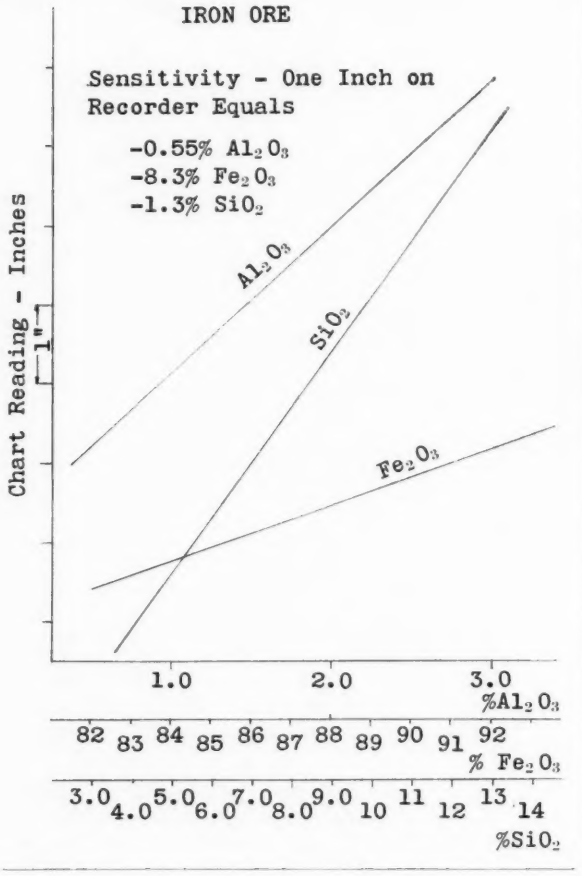
Laboratory studies on samples supplied by mining companies have shown the feasibility of x-ray analysis for zinc, lead, uranium, iron, and nickel in tailings, and it is expected that on-line analysis could be accomplished for these elements by direct analysis of the slurry.

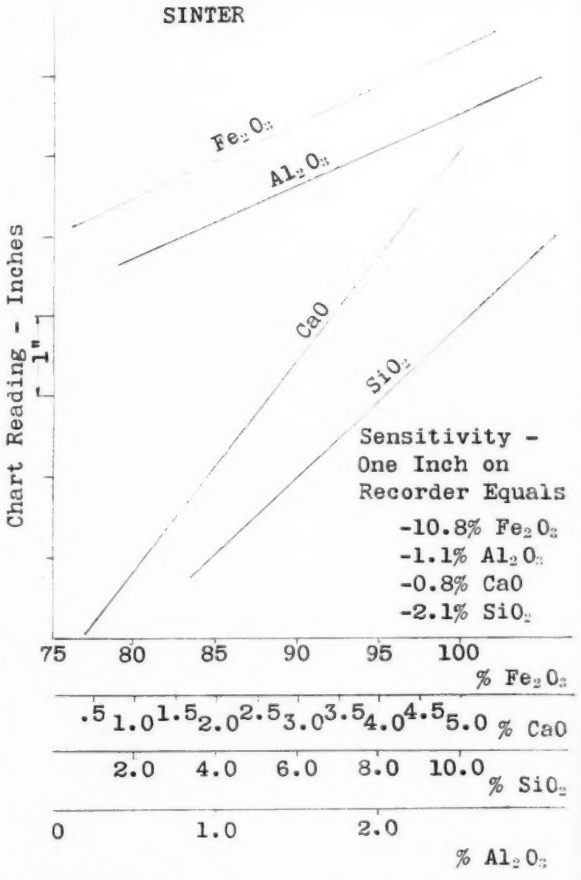
On-Line Control for Potash Processing

Laboratory results on potash samples submitted for analysis were excellent, and indicate a high feasibility for on-line control of mill tails, mill feed, and concentrates. The potash samples submitted were analyzed on both a "normal grind" basis (as encountered in the process) and a fine grind (100 percent minus 200 mesh) basis, and as expected, the finer grind gave slightly better precision, but not significantly enough to warrant additional grinding for on-line analysis. For the concentrates, in a range of 57 to 62 percent K_2O, the accuracy of x-ray analysis was ± 0.2 percent; in a range of only 60 to 62 percent K_2O, the accuracy was ± 0.1 percent. For mill feeds in a range of 16 to 40 percent K_2O, the best accuracy was ± 0.1 percent on a group of samples (figure 4), for another group, whose range was 16 to 26 percent K_2O, the accuracy was ± 0.25 percent. For mill tails, in a range of 1.5 to 3.0 percent K_2O, the best accuracy was ± 0.05 percent; for another group of mill tails, in a range of 0 to 12 percent K_2O, the accuracy was ± 0.25 percent (figure 5).

Although an on-line installation has not yet been accomplished, sufficient laboratory evidence has been accumulated to demonstrate applicability of the XEG to coal analysis for a continuous and on-line analysis for ash and sulfur content.

In a long-range, large-scale project to automate a sinter plant operation, four XEG's are being installed to analyze limestone, ore, coke, and sinter on a continuous on-line basis. All of these gages have been demonstrated as applicable to the analysis requirements on a "batch basis" in the laboratory, using samples supplied by the sinter plant (figures 6, 7, and 8).





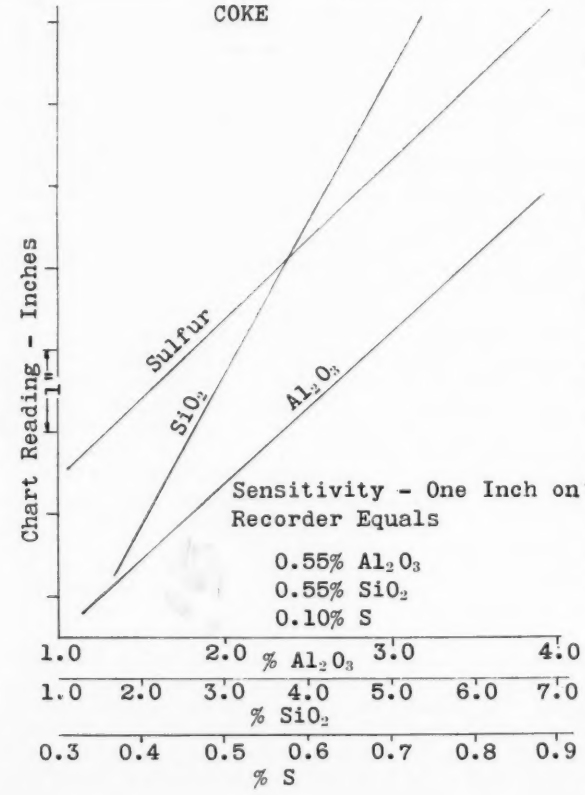


Fig. 6 (upper left), Fig. 7 (lower left), Fig. 8 (upper right) In a long-range, large-scale project to automate a sinter plant operation, four X-ray emission gages are being installed to analyze limestone, ore, coke, and sinter on a continuous on-line basis

Value of X-Ray Analysis Varies with Application

With the advent of simultaneous x-ray instrumentation, in which read-out for a number of elements in any given material can be accomplished in an extremely short time (order of minutes or less), it appears that x-ray "on-line" process control looms into the future of many phases of the mining industry. Once the material from a particular process has been studied in the laboratory and x-ray analysis is demonstrated as feasible to the application, then it remains only to couple the process line to the x-ray analyzer. The ultimate value of such a procedure varies with process application, and the degree of success greatly depends upon the user's ability to determine a point in his process stream for continuous sensing, and to deliver to the XEG a representative portion of his main stream. The value of such an analytical procedure, particularly from a quality control or trend analysis standpoint, can hardly be overemphasized.

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By E. W. PEARSON
Mine Superintendent
Peabody Coal Co.

This new strip mine has a projected capacity of two million tons per year

An eight-yd front end loader is used to load over 300-tph of domestic coal

SUNNYHILL NO. 9

In this brief description a word sketch is offered of the latest Peabody mine—the Sunnyhill No. 9 mine at Moxahala, Ohio.

In the past few years, Peabody has acquired several "ready made" mines —that is to say—mines that were already in operation. But the Sunnyhill No. 9 mine is not one of those. It's an entirely new operation that is expected to produce 2,000,000 tons per year.

Actually, the new Sunnyhill No. 9 mine sprang from a shortcoming. Peabody acquired the Sunnyhill Coal Co. outright in 1959. The Sunnyhill preparation plant at the No. 8 mine was something less than modern. It required a tipple and yard crew of 45–50 men—far beyond economic limits in view of today's small profit margin. Further, it lacked adequate drying facilities and would have required a $250,000 outlay in this respect alone. Those circumstances coupled with the fact that Sunnyhill had mined the locality for 13 years and the plant was no longer central to the coal reserve, prompted the Peabody decision to open a new mine more favorably located in relation to the 20-year field already assembled.

In the prospecting stage 20,000 acres were drilled at 330-ft intervals at the crop—on and off the coal. On the 90-ft cover holes were drilled at 660-ft intervals. Then an aerial mapping service furnished five ft contour maps of the 20,000 acres that had been prospected.

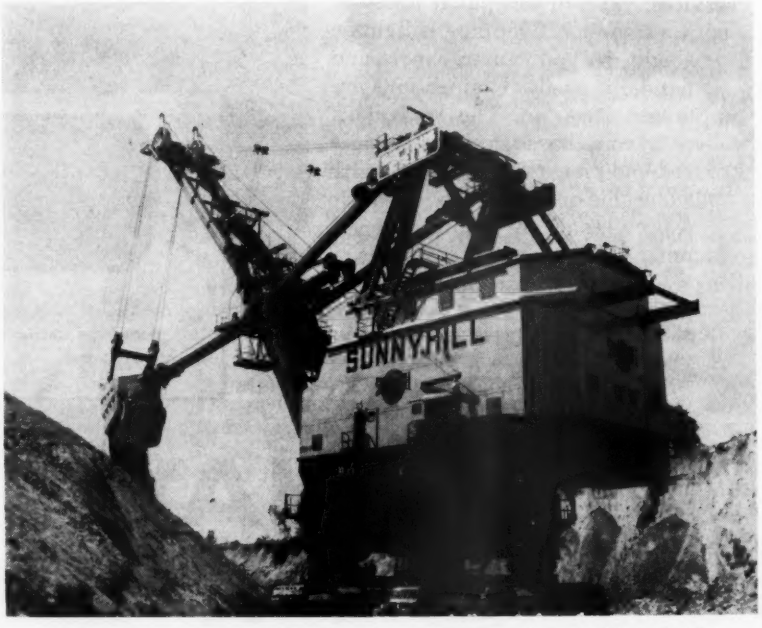
Engineers computed the ton-miles required to deliver from this outlying field to the present No. 8 plant and applying this back against the expected cost per ton-mile, it was found that this developed into a staggering figure—so staggering in fact that it alone justified the building of the new preparation plant centrally located in the new field.

In June 1960 ground was broken for the new mine on the New York Central Railroad near Moxahala, Ohio. The New York Central laid about five miles of mine track, a 370,000,000 gal water supply dam was constructed across the valley, and work began on the erection of the preparation plant.

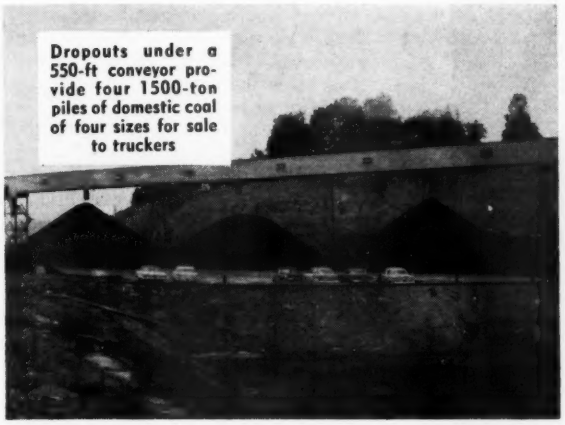
Preparation Plant Completed in November 1960

The plant itself was erected with full speed and production began during the last week of November 1960.

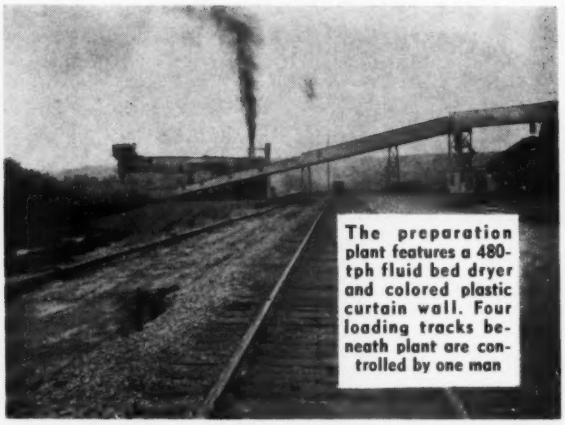
The plant is equipped with a Heyl & Patterson Fluid Bed Dryer and will handle 480 tph of 1¼ in. by 28 mesh. The dryer has no internal moving parts and is the updraft type wherein the hot gases are drawn through a stationary bedplate over which the coal passes from inlet to discharge. The high velocity gas jets suspend the coal and move it along as an agitated, fluidized mass. The larger particles pass across immediately and the finer sizes are lifted



A 65-yd shovel moves up to 150 ft of overburden to uncover the coal. With only 46 in. of coal this is a challenging operation, yet has proven profitable



Dropouts under a 550-ft conveyor provide four 1500-ton piles of domestic coal of four sizes for sale to truckers



The preparation plant features a 480-tph fluid bed dryer and colored plastic curtain wall. Four loading tracks beneath plant are controlled by one man

upward—then dry and finally settle in the quiet zone above the discharge valve. This dryer is capable of reducing the surface moisture from six percent to two percent on 480 tph.

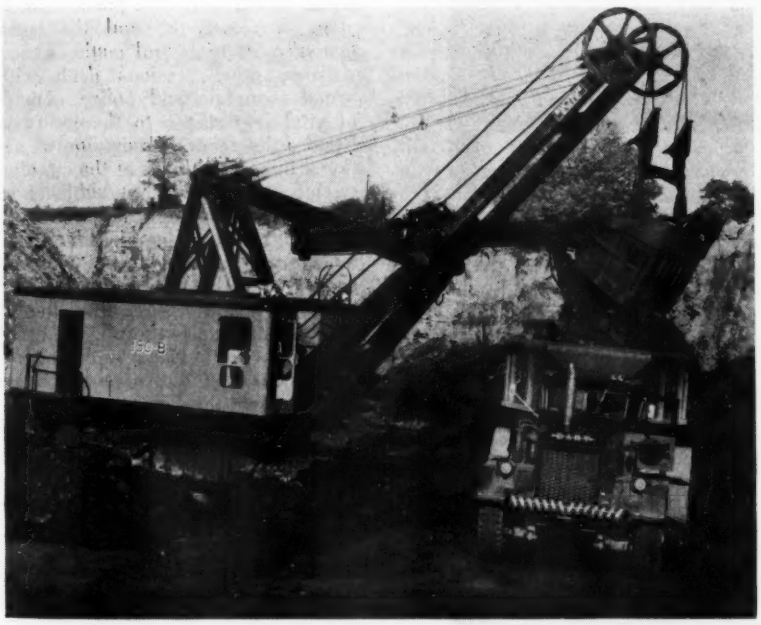
Beneath the plant there are four loading tracks and a yard having an empty capacity of 188 cars. Railroad car movements are all controlled by a car pull operated by one man.

One of the most striking things about the plant itself is the unique siding which is a baked-on plastic process in Peabody's colors and it makes the plant an unusually attractive structure for a coal preparation plant.

Another outstanding feature is the 550 ft long, housed conveyor running from the plant to the domestic coal yard. Four drop outs, each stockpiling about 1500 tons allow four sizes to be stocked for sale to truckers. Three of the stockpile chutes are telescopic cylinders and the fourth, used for the larger sized egg coal, is an eye-catching spiral chute. Domestic truck loading is accomplished with an eight-yd Hough front-end loader capable of loading about 300 tph—quite an improvement over the conveyor type loader which had previously been used for this purpose.

Swinging back to the preparation plant, the raw coal, two-compartment hopper has a capacity of 3000 tons and accommodates both bottom dump Dart trucks and railroad cars of raw coal which are shuttled down from the Sunnyhill No. 8 mine for processing. A car shakeout is mounted over the hopper to expedite the railroad car dumping.

Beneath the hopper, two 60-in. reciprocal feeders, one under each compartment, feed onto a 60-in. ROM, then pass through a 12 ft by 27 ft rotary breaker. The coal is conveyed to the plant by a 48-in. belt conveyor. A flight conveyor feeds two 5-cell No. 5 McNally Pittsburg Jigs and from the jigs it passes to a washed coal classifier. The crushing is done by one two-stage and two single-stage crushers.



The 46-in. Ohio No. 6 seam is loaded into 50-ton trucks by a 7½-yd shovel

Stripping with 65-Yd Shovel

At present, the stripping is accomplished with a 1650-B, 65-yd shovel; the loading with a 150-B, 7½-yd; and the haulage by four 50-ton Dart units. Drilling is done with a Bucyrus-Erie 40-R drill—and of course there are the usual dozers, grader, utility vehicles and affiliated equipment.

The seam mined is the Ohio No. 6 or Middle Kittanning seam averaging 46 in. of coal and two in. of binder, under an overburden running up to 130 ft. While this isn't exactly gravy, the seam is consistent and predictable and can be mined profitably.

Adjacent to the preparation plant is a 235 ft by 67 ft building which houses the shops, warehouse, and offices, all under one roof. The shop is modern and roomy, and the offices are air-conditioned and handsome in relation to the average mine field offices.

Problems?—yes there have been and still are problems. The dryer created quite a dust problem making it necessary to install cyclone dust collection in the dry-cleaning section of the plant—and even to date, the problem has not been satisfactorily resolved. And of course, there are other phases of the operation which do not yet measure up to standards.

What's in the future? Well, the new Sunnyhill No. 9 mine may well grow into one of Peabody's best strip mines. Already they're talking about 2,000,000 tons per year.

THE Seattle Story

Metal Mining-Industrial Minerals Convention attracts more than 2200 to discuss industry problems

THE 1961 AMC CONVENTION in Seattle September 10–13 attracted mining men from all levels of management and operations to the Pacific Northwest for one of the finest meetings ever held by the industry. Those in attendance included, in addition to members of Congress and prominent officials from Government departments, mining executives, managers, engineers, scientists and other key officials and technical men from all parts of the United States and from other countries, representing every branch of mineral production. Together they reviewed the industry's pressing problems—economic, legislative and technical—and discussed them from all angles.

The meeting rooms at the Olympic Hotel were filled with eager listeners, intent on exchanging ideas and gaining information from the 117 carefully selected and well qualified speakers. In all, there were 17 sessions, 10 of which were primarily directed to operators, engineers and mine managers. These highlighted significant phases of mineral exploration, new open pit and underground mining practices and equipment, and developments in mineral beneficiation. They included also special sessions on maintenance, general operating developments, and the latest management tools and methods.

Seven other sessions dealt with broad economic and policy matters of vital importance to the industry. Besides the general discussion of national mineral policies at the opening session, such important subjects as public lands; taxation; labor and industrial relations; gold, silver and monetary problems; safety and health, and the current status and outlook for the various branches of the industry were thoroughly aired by leaders in industry and Government. An account of each session is given later in this report.

DECLARATION OF POLICY

An industry-wide Resolution Committee, headed by Kenneth C. Kellar of Homestake Mining Co., drew up and submitted to the Convention a series of statements to set forth the industry's views on major national policies which affect mining.

This "Declaration of Policy" af-

fords a guide for the American Mining Congress in its day-to-day work on behalf of the industry, and serves as a medium for acquainting the public, Federal officials, and members of Congress with mining's problems and the policies needed to maintain a vigorous, efficient industry.

The "planks" of the policy declaration were presented at appropriate sessions of the Convention, and were strongly endorsed by the industry. The full declaration as adopted appears on pages 27 to 33.

CONVENTION OPENS WITH SUNDAY RECEPTION

Mining men and their ladies gathered in the beautiful ballrooms of the Olympic Hotel Sunday afternoon, to be received by the top officials of the American Mining Congress and to see old friends and meet new ones at a festive cocktail party to which all those attending the Convention were invited. Although primarily a social event, mining people found themselves "talking shop" as they sought to learn what was new in the industry away from their own back yards.

WELCOMING LUNCHEON

At the traditional Welcoming Luncheon on Monday noon, the mining fraternity "paid respects" to its hosts—the Pacific Northwest, the State of Washington and the city of Seattle.

Following the invocation by the Rev. Martin L. Goslin, D.D., of the Plymouth Congregational Church of Seattle, Robert M. Hardy, Jr., chairman of the Western Division of the American Mining Congress, called on the Mayor of Seattle, Gordon S. Clinton, who welcomed the miners.

Brief responses were made by Raymond E. Salvati, chairman of the board, Island Creek Coal Co. and president of the American Mining Congress; J. C. Kieffer, manager, Northwestern Mining Dept., American Smelting & Refining Co. and national chairman of the Program Committee; D. E. Davidson, vice president, Link-Belt Co. and chairman of the AMC Manufacturers Division; and Jesse F. Core, vice president—Operations—Coal, U. S. Steel Corp, and chairman of the AMC Coal Division. Hardy then introduced leading government officials and mining executives who were seated at the head table—including, of course, his co-chairman of the General Committee, S. M. Strohecker, Jr., of E. I. du Pont de Nemours & Co., Seattle.

The climax of the luncheon was an address by Governor Albert D. Rosellini, who expressed his pleasure in welcoming the mining men and ladies to the State of Washington. The Governor assured the miners that the western states are fully aware of the necessity of finding and developing the hidden mineral wealth residing within their borders, and expressed hope that the Federal Administration will take a positive position in developing a National Minerals Policy. He told about the work of the Western Governors, who have held annual conferences and taken definite stands in favor of mining development in the West. Reviewing the industry's contributions to the economy of Washington, he went on to describe some of the work which various agencies in the State have done to encourage mineral development.

Western Division Chairman "Bob" Hardy presided over the Welcoming Luncheon at which Washington's Governor Rossellini made a stirring address

Rosellini concluded his remarks by inviting the audience to the "Century 21" Exposition to be held in Seattle next year.

BOARD OF GOVERNORS LUNCHEON

The Board of Governors of the Western Division of the Mining Congress met at luncheon Wednesday, with chairman Robert M. Hardy, Jr., presiding.

Members of the Board for the coming year, as nominated by the various State mining organizations, were unanimously elected, and Donald H. McLaughlin, chairman of the board Homestake Mining Co., was elected chairman of the Division for the coming year.

P. R. Bradley, Jr., and S. H. Williston expressed pleasure that the 1962 Mining Show will be held in San Francisco, September 24–27, and made it clear that a topnotch meeting is in prospect.

Invitations were extended to hold meetings in Los Angeles in 1963; Portland in 1964; and Las Vegas in 1965. They were received with appreciation, and Mining Congress officials will work out the necessary arrangements.

AMC president Raymond E. Salvati announced that he was terminating his office as president at the end of this year, and expressed his appreciation for the privilege of serving in this post and having the opportunity to become so well acquainted with the people of the West. He said he

Donald H. McLaughlin of San Francisco was elected Western Division Chairman of the Mining Congress for the coming year

planned to continue the fine relationship over the years ahead, and complimented those who helped in developing the Seattle meeting for their splendid work. Brief remarks were made by J. C. Kieffer, chairman of the Program Committee, D. E. Davidson, chairman of the AMC Manufacturers Division, Jesse F. Core, chairman of the AMC Coal Division, and Kenneth C. Kellar, chairman of the Resolution Committee.

SECRETARIES' BREAKFAST

The 24th annual breakfast session of State and regional mining association secretaries was held Sunday, with Al Teske, secretary, Idaho Mining Association, presiding. Topics discussed included the pending Wilderness bill as recently passed by the Senate, other public lands matters, the gold situation, Federal mine inspection, and water pollution abatement.

Unable to be present was "Charlie" Willis, secretary of the Arizona Small Mine Operators Association, who had been a leader in starting these annual get-togethers. A special telegram of greetings and good wishes was dispatched to Mr. Willis.

SPECIAL LADIES PROGRAM

Many miners brought their wives to Seattle, where they enjoyed a special program arranged for them by the Ladies Committee headed by Mrs. Robert M. Hardy, Jr. and Mrs. Woodfred E. Romig as co-chairmen, with Mrs. R. M. Hardy, Sr. as honorary chairman. This included a flower arrangement luncheon on Tuesday and a brunch, cruise on Lakes Union and Washington, and sight-seeing trip on Wednesday. In addition the ladies attended the evening events, and many of them took part in the trips on Thursday.

EVENING ENTERTAINMENT

An outstanding schedule of social activity for the miners included a "Potlatch" celebration—an old time Siwash Indian festivity—in the National Guard Armory on Monday evening. Following a complimentary cocktail hour, there was a genuine Indian feast of barbecued Quinault salmon, a special entertainment program and dancing till midnight—providing an ideal setting for miners to mingle with their friends and broaden their acquaintance in the industry.

A fitting climax to the Convention was the "Speechless" Banquet on Wednesday evening. An excellent dinner was served to a capacity crowd, following which Cris Dobbins, president of Ideal Cement Co., wove some congenial good humor into his introductions of the head table dignitaries. The sparkling entertainment program which followed was highlighted by the singing of the noted tenor, Arthur Lee Simpkins.

SALMON DERBY

Early on Tuesday and Wednesday mornings, some 180 sports-loving miners took part in the AMC "Salmon Derby." After a hearty breakfast they went out on Puget Sound to learn that there still may be some question as to whether fish are smarter than people. The fish weren't biting, but the outing was none the less successful—the scenic beauty of the Sound, with the snow-capped Mt. Rainier catching the sunrise colors, affording an experience that will be long remembered.

Prizes for the largest fish were won by Robert M. von Storch of Dragerton, Utah, and W. N. Brown of Denver.

TRIPS

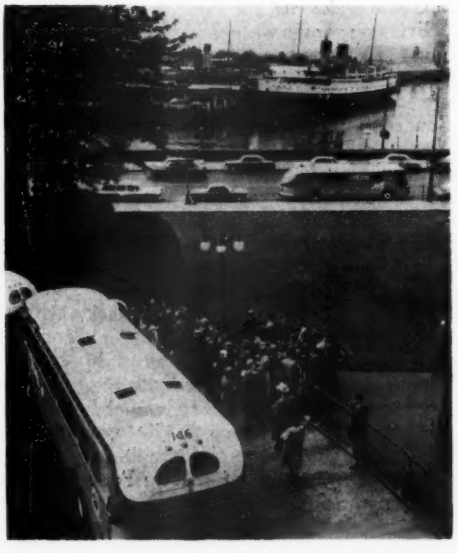
On Thursday following the business sessions, many convention-goers took advantage of the four special trips arranged for them. Most popular was the cruise to Victoria, an all-day trip starting out on the Canadian Pacific Steamship, Princess Marguerite, which took the group to the docks in front of the Empress Hotel, where they had lunch. They then toured the city and its many attractions and the world-famous Butchart Gardens—with time left over for browsing in Victoria's typically English shops before a relaxed return voyage to Seattle.

A second trip was an all-day tour of Mount Rainier National Park. Traveling some 200 miles in all, the bus completely encircled the mountain, traversed four summits, and made numerous stops along the way to view the rugged heights and the autumn foliage.

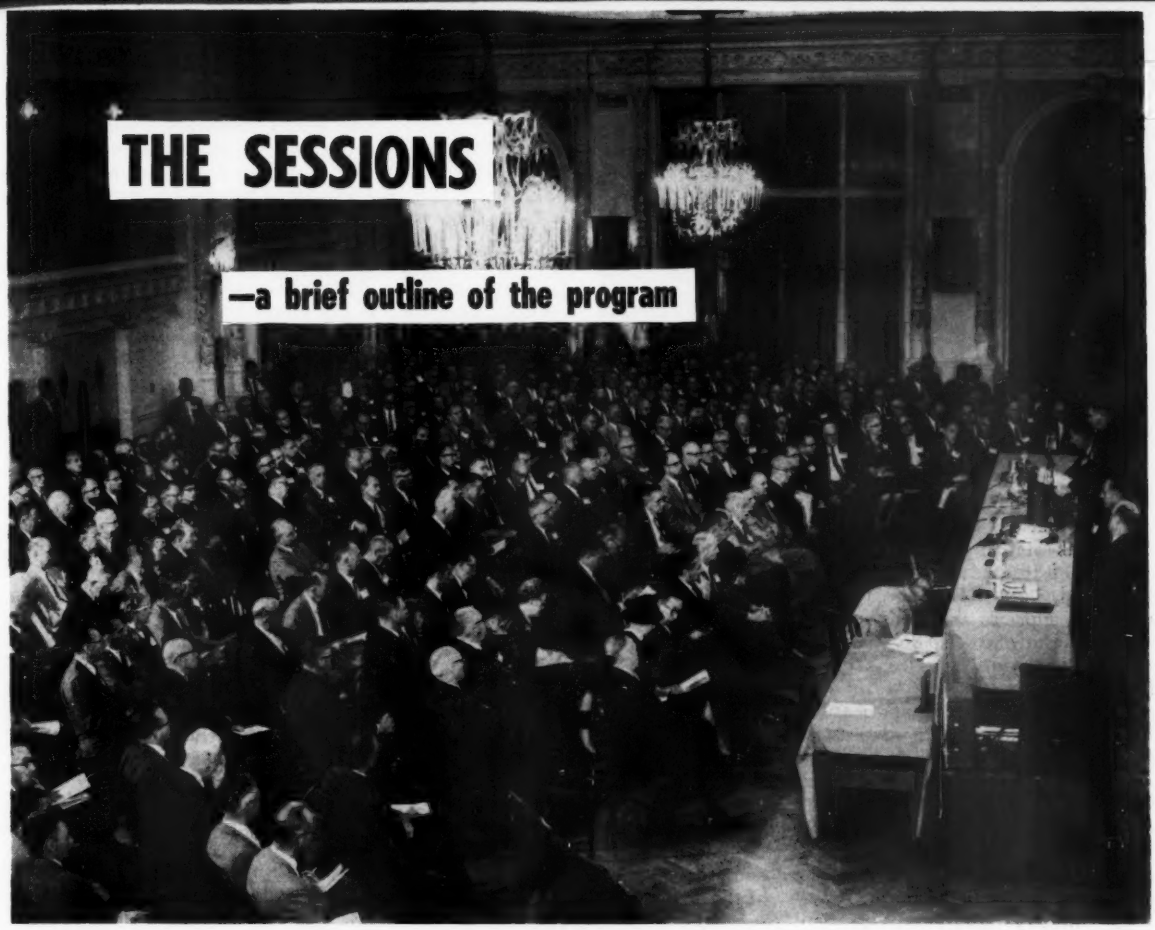
Two industrial tours were enjoyed by some 60 visitors. They were half-day trips to Bethlehem Steel's Seattle plant and to the Boeing Airplane Plant at Renton. The Bethlehem trip included a thorough inspection of one of the world's most modern steel plants; on the Boeing trip the visitors saw the giant 707 jet-liner and the smaller 727's and 720's in actual production.

SAN FRANCISCO NEXT YEAR

With the Convention in Seattle now over, the eyes of mining men everywhere are turning to San Francisco where the American Mining Congress will hold its 1962 Mining Show in Brooks Hall and the Civic Auditorium. But before leaving Seattle, it is appropriate that the industry express its appreciation and gratitude to the chairmen and members of the Convention committees, to those who took part in the program, and to the many others in Seattle and throughout the industry who helped to make the 1961 meeting one of the most successful in AMC history—including the weatherman, who provided cool nights and brisk sunny days!



Many convention-goers visited Victoria, B. C., on Thursday following the business sessions



THE SESSIONS

—a brief outline of the program

Editor's Note: Any summary of the many viewpoints and reports of progress in the mining industry presented at the Convention is inevitably inadequate and fails to bring out the full scope of the discussions, or the many interesting features of the operating and technical papers—most of which will be published in more complete form in later issues of the Journal for the benefit of our readers.

NATIONAL MINERAL POLICIES

THE CONVENTION WAS officially opened Monday morning by Raymond E. Salvati, president of the American Mining Congress. After presentation of the colors by a group of Boy Scouts, Mr. Salvati introduced Kenneth C. Kellar, chairman of the Resolutions Committee, who presided during the remainder of the session.

John M. Kelly, Assistant Secretary of the Interior, outlined the Administration's views on national mineral policies. He said the Interior Department is undertaking a comprehensive review of the domestic mining industry to ascertain some of the basic causes for the depressed condition in some segments of the industry and to see what the Government should do.

He stated that our national security with regard to most minerals and metals is relatively better than many other aspects of our security. "The task now with regard to security," he continued, "is to maintain a constant review and make needed adjustments to changing circumstances. This involves periodic reviews of requirements and continuing appraisal of sources of supply in order that the mobilization base shall be maintained."

Kelly declared that his Department intends "to champion the American minerals producer in whatever Governmental problems he is involved and to assure that his legitimate interests are given full weight in the final decision."

The next scheduled speaker, Sen. Henry C. Dworshak of Idaho, ranking Republican on the Senate Interior Committee, was unable to be present. His prepared remarks were read by Charles E. Schwab, president, The Bunker Hill Co., Kellogg, Idaho. In his statement, the Senator said that the basic factors which have caused the present plight of the mining industry are "our Government's policy with respect to international trade and our position on foreign aid."

Government subsidies to domestic

Session on Labor and Industrial Relations —left to right, Congressman John Dent of Pennsylvania, former Congressmen Pat Hillings of California and Graham Barden of North Carolina, Program Committee Chairman J. C. Kieffer

industry would be unneeded if it were not for our foreign aid program, Dworshak stated. "We should help our less fortunate foreign friends," he added, "but it is time to completely reappraise this program and determine how we can do it without putting taxpaying Americans out of business."

The Senator noted that measures have been introduced to give assistance to domestic industries, but to no avail. "Always the final verdict has been rendered by the State Department that this or that type of relief measure would seriously impair our efforts to assist foreign nations," he declared. "If this disregard for American industry continues, we will either have to see our standard of living go down, or we will have to move even further toward socialism."

Rep. Walter Rogers of Texas, high ranking Democrat on the House Interior Committee, reviewed Federal laws and policies which have benefited the mineral industries, including the basic mining and mineral leasing laws under which discovery and development of mineral resources by private enterprise has been encouraged.

Rogers then called attention to current international trade problems affecting U. S. industry generally, problems which involve the six- and seven-nation European common market groupings and the eventual Russian move into consumer goods areas. "Now the problem is," he said, "that we in this country have to be smart enough to put all of our problems together, whether it be in the mining industry, whether it be in agriculture, whether it be in the manufacturing industry, or whatever it is, and say to ourselves, this is a matter that involves our entire country. It is a matter in which we must all put up a united front. It is a matter in which America, the United States of America, must come first."

Rogers urged the mining industry, in helping to solve national problems, to start from the premise of what is the best interest of the United States.

LABOR AND INDUSTRIAL RELATIONS

PRESIDING AT THE Monday afternoon session on Labor and Industrial Relations was Program Committee chairman Joseph C. Kieffer. First speaker was former Rep. Graham Barden of North Carolina, who for many years was chairman of the House Committee on Education and Labor and who participated in the drafting of the Taft-Hartley Act and other major labor-management statutes.

Barden said that the goal of unions once was improvement in wages, hours and working conditions, but now their program covers everything "that is covered in the Democratic or Republican platforms" and is no longer limited to economic reform. To combat social and political "reforms" urged by unions, Barden urged businessmen to work harder for good government.

"Good government is not automatic," he stated. "It's been the result of spilling blood and the working interest of citizens ever since government appeared. It is important to you, but it must be run by competent men if you expect to preserve the kind of government you desire."

Rep. John H. Dent of Pennsylvania spoke on the effects of imports on the domestic economy. He emphasized the need for major changes in both foreign aid and the trade agreements program to protect American business and jobs. "The day must come," he said, "when we realize that unless we protect our home economy, we can't help the underdeveloped nations or anyone else, including ourselves."

He pointed out that Congress, in approving this year's foreign aid bill, had made some progress by adopting an amendment providing that any nation would disqualify itself from receiving aid if more than 20 percent of the resulting industrial, mine or agricultural production was exported to the United States. Dent said that this amendment, which he joined in sponsoring, "lays down the principle that Americans should not be taxed to put themselves out of business, out of jobs, and into industrial oblivion."

Patrick J. Hillings, former U. S. Representative from California who now is regional civic and governmental affairs manager for the Ford Motor Co. at Los Angeles, spoke on "Industry's Position on Practical Politics." He urged his audience to recognize that today it is more important to be active and responsible in the field of politics than perhaps in any period in history "because the challenge to our system today is greater than ever and we're getting pretty close to the line now where we're standing alone as the last bastion of individual freedom and free enterprise in the world."

Hillings outlined the measures which the Ford Motor Co. uses to encourage political participation by its employes in either party, with supervision of the program by executives who have time to devote to this task. He emphasized his company's belief that political activities should be conducted through either of the two parties and should not be based solely on issues. "If you're going to be in practical politics," he said, "you've got to get practical, and the practicalities are that you have to work through a party, a political organization."

PUBLIC LAND PROBLEMS

ONE OF THE highlights of the Convention was the session on Public Lands held Tuesday morning, September 12. In the absence of chairman Wayne N. Aspinall of the House Interior Committee, who was kept in Washington by the press of legislative matters, Rep. Walter Rogers of Texas presided. He called upon Milton Pearl, mining consultant to the House Interior Committee, to present a brief message from Congressman Aspinall.

In his message, Aspinall emphasized that the adoption of a permanent multiple use policy is an essential cornerstone of good public land management. He called attention to a bill which he had recently introduced which would extend to public lands administered by the Secretary of Interior, the principles of multiple use and sustained yield management established by Congress last year as the

policy for the administration of National Forest lands. He said that if the term "multiple use" means allowing more than just a single use of an area, and, in fact, means what the term suggests, "I can assure you not only of my own support but of the endorsement and support of the members of the Committee of which I am Chairman." He declared that unless Congress determines it to be in the national interest for particular areas, such as National Parks, to be designated for specified use, "all lands will be available for grazing, mining, watershed, timber and recreation or fish and wildlife development." He also expressed pleasure that the Mining Congress was giving attention to the problem of protecting those whose mining explorations lead to discoveries and said that he was looking forward to the intelligent recommendations of the industry.

The Public Lands session featured top-level Government and industry spokesmen: Howard Twitty, BLM Director Karl S. Landstrom, G. H. Ladendorff, W. Howard Gray; seated, Hon. Walter Rogers, Milton A. Pearl

Presenting the Administration's views as to public land policies, Assistant Secretary of Interior for Land Management John A. Carver, Jr., told the mining industry that unyielding opposition to a Wilderness Bill on the ground that it is an infringement upon a precious right of old prospectors to ply their romantic trade, or as a "lock-up" of mineral resources is shortsighted and of debatable wisdom. He said there is increasing demand from the American people which is reflected in their representatives in Congress, for added recreational facilities, for more parks, for undisturbed shorelines, and for wilderness and that this demand must be satisfied.

Carver went on to state "I am not saying that your opposition to the Wilderness Bill or any other legislation ought to be quelled or even muted, if you feel it is against your interest or your view of the national interest. I do think, however, you ought to be giving more thought to how your own interests and these other interests can be accommodated, honestly and fairly."

He told the Convention that he would like to keep the 1872 mining law and the Taylor Grazing Acts "as they are, and in any event keep the principles they contain" but that to keep them, the miner and the grazer "are going to have to come to grips with the realities of the last half of the 20th century—exploding population, increased leisure, more money and fantastic mobility of the people." He said "you can't confine your Association's attention to 'improvements' of the Mining Act of 1872, or the Mineral Leasing Act of 1920. You have a stake also in the reform of outmoded agricultural entry laws; in improved land use programs; in better cooperation with State and private owners; in land classification. You have a stake, too, in recreation. To oppose a Wilderness Bill, or the creation of a national park or monument as inimical to mining may save you, temporarily, the privilege of doing more prospecting—at the expense, perhaps, of another straw of ill-will to the principle of the 1872 Act and your profession generally."

The problem of "discovery" on mining claims was discussed by Karl S. Landstrom, director of the Bureau of Land Management and Howard Twitty, attorney of Phoenix, Ariz.

Landstrom said that every year thousands of mining claims are located for every conceivable use other than mining and estimated that there are at least 10,000 cases on the national reserve and a like number in the national forests. He declared that much of the misuse stems from incomplete law enforcement. He went on to point out that unauthorized land uses will receive close attention and will be eliminated where possible. He said the Department is presently acting against nearly 2000 such claims recently located in Southern California, and against locations made on reserved mineral interests of suburban lands near Tucson, Ariz.

Turning to the question of discovery, Landstrom said his remarks only concerned the location, entry and patenting as between the United States and a mineral claimant. He stated that there are two distinct classes of locatable minerals—those of intrinsic value, such as gold and silver, and those of market value only, such as uranium, ores, limestone or gypsum. As to intrinsic value minerals, Landstrom said the prudent man rule was generally followed but added "if we could all agree how a prudent man would think and act under each and every fact situation, the determination of discovery might possibly be reduced to a black and white proposition." He stated that a prudent man would necessarily take into account the size of the vein, as far as disclosed, the quality and quantity of minerals it contains, its proximity to working mines and location in an established mining district, the geological conditions, and other like facts. As to minerals which do not have intrinsic value, he said marketability of the material is among the criteria to be considered. He stated that the requirement of marketability has been consistently maintained by the Department, and approved by a U. S. Court of Appeals in 1959. He emphasized that "making a profit is of course closely associated with the idea of being prudent, and the value of a mineral deposit may generally be measured in terms of its potential to produce a profit." He singled out uranium for comment by saying that if a prospector should discover a mountain of uranium ore today he would find that there is no market for the material and none is in sight.

Landstrom suggested that the Department may seek to obtain changes in the mining laws to provide for (1) elimination of the distinction between lodes and placers, (2) location of all claims by legal subdivision, (3) abolition of extralateral rights, and (4) recordation of location notices in the Land Offices.

Howard Twitty took direct issue with Landstrom, declaring that the mining industry has traditionally applied the prudent man test, as set forth by the courts, in connection with making a discovery. He said "the Interior Department today does not

apply this test in all instances, and I might say in a certain class of instances, that is where there are minerals of widespread occurrence, it has another test which they call the marketability test." He said Landstrom included uranium as one of the materials subject to the marketability test, and emphasized he did not believe that this could be the test for uranium. He declared that the marketability test has been before one court and expressed the view that it should be placed before other courts and the U. S. Supreme Court and should be rejected.

Twitty went on to say that "not only has the decision of the Department of Interior added the marketability test to the prudent man test in cases of minerals of widespread occurrence, but it appears to some of us that there is a trend to add this marketability test in cases involving deposits of limited occurrence." This trend, he said, is evidenced in recent decisions requiring a deposit to be explored to such an extent as to prove the existence of an ore body of such size and quality as to permit a profitable operation. He said that such decisions amount to administrative legislation wholly unwarranted by a fair interpretation of the mining laws. He told the Convention that until these decisions are overruled by the Department or by the courts, "it is only sensible for us in the mining industry to obtain, if possible, in any contest or hearing in connection with patent proceedings, the kind of evidence to prove discovery that is now required by the Department." He also suggested that patent proceedings not be initiated by holders of mining claims unless they are certain that they have a discovery of minerals by the Department's standards. "Otherwise," he said, "they may find they have commenced a proceeding for patent which will only result in the adjudication as null and void of their valuable mining claims."

W. Howard Gray, chairman of the American Mining Congress Public Lands Committee, reported to the Convention on the pending Wilderness Bill. He pointed out that the Mining Congress had opposed the measure before the Senate Interior Committee and during its consideration by the Senate and urged members of the industry to enlarge and intensify its efforts in opposition to the bill, which has now passed the Senate.

Gray emphasized that the measure withdraws huge areas of public lands from mineral activities and that language in the measure which purports to permitting prospecting is ineffective. He said if prospecting must be compatible with the preservation of the wilderness system, as the bill states, then there can be no activity for the discovery of minerals, and it is effectively prohibited.

Gray pointed out that action on the Wilderness Bill comes at a time when the United States faces a tough international situation and may need to call upon its natural resource industries for the supplies vital to its national defense. He said if we are to convince the Russians that they are the ones who will suffer the greatest by international conflict, then our armed forces must be supplied with the necessary materials of war and supplied to the extent that the quantity thereof constitutes the convincing argument. He told the mining men "it is to the natural resources of his country that Krushchev turns to equip his armies, his navies, and his air fleets, and there is no talk in Russia of preserving 'wilderness' for meditation for solitude, for contemplation and for admiration. With your life at stake, your mind is far more occupied with something more realistic, more personally important than to wonder and marvel at the growth of a mighty pine, the tinkling music of a waterfall, and the calmness of a mountain lake at sunset."

He said if Congress enacts the wilderness legislation it will repudiate the multiple use program which has been backed by the mining industry, and abdicate legislative authority in direct conflict with the Constitution of the United States.

"The cold fact," Gray said, "is that under the law at the present time, wilderness areas have been created, primitive areas have been created, wild areas have been created, all done either by the Department of Agriculture or the Department of Interior, and steps have been taken by those Departments to preserve the wilderness characteristics of the areas involved. Notwithstanding this, however, the mining laws still apply, locations can still be made, and mining can be carried on in the wilderness areas, the wild areas, and the primitive areas designated by the departments. True, these Departments may create regulations, but they cannot create restriction. So far the regulations have been regulations with which industry could live, and the regulations have been directed to practices which are not countenanced by the mining industry itself.

"In 1955 the mining industry backed wholeheartedly and sincerely Public Law 167 which created multiple use and affected mining. The thought behind that legislation was the lands of the United States should be put to their highest use, and that all users thereof should work together for the purpose of utilizing the land to its greatest productivity. With the passage of S. 174, our economic welfare, our standard of living, our international position have all been relegated and made subordinate to contemplation and meditation."

Following Gray's talk, the industry was brought up to date as to developments connected with the preparation of a proposed bill to provide for exploration claims by G. H. Ladendorff, attorney of Phoenix, Ariz.

Ladendorff said that since this subject had been discussed at Las Vegas a year ago, a considerable number of mining attorneys, geologists, and mine operating officials had reviewed the original draft of the proposed measure. He also pointed out that it had been discussed with officials of the Interior Department under the Eisenhower Administration and that as a result of these reviews and discussion some changes which were considered desirable had been made in the proposed bill. With the change in Administration, further conferences were held with officials of the Interior Department and the proposed measure given them for study. While the Department has not yet fully completed its study, it has suggested some revisions, Ladendorff said. These are now being considered by the group drafting the bill. Copies of the revised industry draft are available from the Mining Congress, he pointed out.

The mining attorney told the Convention that since the Mining Congress had begun working on the measure, both the States of Arizona and Alaska, have adopted laws relating to State lands, similar to that being proposed for prediscovery protection on public domain lands. He made it quite clear that future efforts with respect to the proposed exploration claims bill will continue to be devoted to seeking a measure that will provide prediscovery protection without changing the General Mining Laws of 1872.

Ladendorff also referred to remarks made by Landstrom with respect to the validity of mining claims. He said "we have no quarrel with the position which would be taken by the Bureau of Land Management on this point if it involves claims which have been sitting around, and which have no discovery. But if this involves an at-

Donald B. Macurda, R. M. Hardy, Jr., and Percy L. Greaves, Jr., presented the problems of Gold, Silver and Monetary Policies

tack upon the right of the prospector to go on the public domain, locate a claim and search for a discovery. which is of course what we do, then I think that the Department may be running head on against the law which has been established for many years, both by statute and court decisions, and which encourages prospectors to go upon the public domain and search for minerals."

TAXATION

THE TAX PANEL on Tuesday afternoon was presided over by L. J. Randall, president of Hecla Mining Co. He explained to the audience that Congressmen Victor A. Knox (Rep., Mich.) and Cecil R. King (Dem., Calif.), who were scheduled to speak, had been forced to cancel out at the last moment because of urgent business before the Committee on Ways and Means—of which both are members.

Former Senator Thomas E. Martin presented the speech which Congressman Knox had prepared, discussing his efforts and the efforts of Senator Wallace F. Bennett (Rep., Utah) to establish the allowability of crushing and grinding of all minerals for depletion purposes. These efforts have resulted in Treasury commitments that crushing and grinding will be allowed to the producers of crushed stone for years prior to 1961, and that concentrating of uranium will also be allowed for such years.

In the absence of Congressman King, AMC Counsel Brice O'Brien gave a run-down of the "discussion draft" which the Ways and Means Committee has published and will consider early in 1962, growing out of the President's recommendations for tax revision.

Ellsworth C. Alvord, Tax Counsel for the American Mining Congress, discussed economic trends. Although Alvord feels that Russia will not start an all-out war, he pointed out that tremendous expenditures are necessary in order to deter aggression and such expenditures will have a profound impact on our economy. He said we may very well be faced with increases in the already-heavy tax burden if there is no improvement in the international situation.

GOLD, SILVER AND MONETARY POLICIES

CHAIRMAN OF THE Tuesday afternoon session on Gold, Silver and Monetary Policies was Robert M. Hardy, Jr., president, Sunshine Mining Co., Spokane, Wash.

"Our Monetary Crisis" was discussed by Percy L. Greaves, Jr., a widely known economist from Dobbs Ferry, N. Y. Since establishment of the Federal Reserve System before World War I, he said, the country has been increasingly reliant upon a managed currency, with the result that some $220 billion are now outstanding against a gold supply of $17.5 billion.

To ward off an increasingly Government-controlled economy, Americans must have the right to own gold in a free market, he declared. In turn, Greaves continued, the ratio of dollars to gold would be established and "we can then go on a regular gold standard with gold coins in the pockets of those Americans who wish it, and if their politicians start to issue more dollars, they can put a brake on it by demanding and turning their dollars in for gold coins. That will put an end to the spending policies as quickly as we can."

Greaves added: "If we are to remain free, we must regain the right to own and use monetary gold and never again let politicians print money or get their hands on the money we put in the bank and which they use to support their bonds. . . . When we stop inflations we'll stop the cause of depressions."

Donald B. Macurda, a partner in F. S. Smithers & Co., New York, spoke on "Silver's Position Today." In summing up the domestic industrial demand-production relationship, he said domestic mine production has not begun to match industrial requirements since 1940. Even the war-stimulated production of 71 million ounces in 1941 would have been insufficient to meet industrial demand in any subsequent years, he stated, while the domestic mine production figure for 1960 of just under 30 million ounces falls woefully short. If the Treasury should come back to the domestic market for its annual coinage requirements, he added, another 45 to 50 million ounces of annual output or imports would be necessary.

With or without Treasury coinage demand, Macurda added, the domestic situation—excluding Treasury sales and imports—would warrant a substantial improvement in silver prices.

He also pointed out that even a maximum rise of 30 cents in the price of silver would be considerably below the amount of the luxury tax of 10 percent collected on a six-piece silver place setting. "There would appear to be more point for silver users to concern themselves with the removal of the luxury tax than to inveigh against a price rise in the metal itself," Macurda stated.

STATE OF THE MINING INDUSTRY

R. L. McCANN, president, The New Jersey Zinc Co., presided at Wednesday morning's session covering the economic status and future outlook of the various branches of the mining industry.

The first presentation, devoted to the state of the copper industry, was made by James Boyd, president, Copper Range Co. Although production capacity in the free world today is in excess of normal demand, a condition that will continue about five years, Boyd said, the state of the copper producing industry is very good at

Speakers at the session dealing with the State of the Mining Industries: R. L. McCann, Walter L. Rice, R. M. Foose, Clark L. Wilson; seated, James Boyd, Carl B. Jacobs, David L. Francis

the present, and the future is bright. Although there are problems, worldwide production and distribution by the industry are now massive enough that disruptions in any one place no longer cause severe reactions on the world market as was the case formerly.

Boyd pointed out that it is vital that the industry continue, and even accelerate its search for new deposits and means of recovering copper economically from lower grade deposits. To this end, exploration has finally become accepted as a necessary part of production cost, and consumers must expect this cost to influence prices.

Boyd concluded by saying the copper industry is becoming wiser in its collective knowledge of itself, and should no longer be thought of as a widely fluctuating, unmanageable monster. Consumption will steadily increase, prices should be more stable, and slightly higher than today, and production will increase to meet the need.

In summarizing the current lead-zinc situation, Clark L. Wilson, chairman, the Emergency Lead-Zinc Committee, said, "Domestic mine and smelter production continues at a reduced basis; consumption has been poor but it is improving. . . . imports are still excessive, stocks continue to be a real problem in spite of voluntary domestic cutbacks, and the price remains weak. This situation will continue as a long-term problem until excessive imports are controlled or until consumption makes some phenomenal gains."

Wilson stated that the lead-zinc industry's problem isn't in Congress, but lies in the Executive Branch. He said the Administration opposes any increase in duties on lead and zinc, but proposes a very limited subsidy. This is termed a "phase-out" program which recognizes that, because the Government encouraged lead-zinc miners during the war years, these miners should be permitted to gain some return on their investment. In conclusion, Wilson strongly urged that everyone connected with the lead-zinc mining industry should call attention of the President, the Secretary of the Interior, the Secretary of Commerce and the Secretary of State, as well as Senators and Representatives, to the need to protect the domestic industry.

Carl B. Jacobs, vice president of raw materials, Inland Steel Co., described the iron ore industry as having an oversupply at the present time, and having enough ore under development for at least the next decade. He pointed out that in 1953 the iron mining industry in the United States and Canada had developed the capacity to produce 124,000,000 tons of usable ore annually. Most of this capacity is still available, and to it has been added 30,000,000 tons per year of high grade concentrates and pellets from new plants built to meet the changing demand of the steel industry. An additional 21,000,000 tons of annual capacity is planned for completion by 1965.

In looking to the future, Jacobs said, "An ever-increasing percentage of today's iron ore production is captive tonnage, and this trend will continue."

Because of phenomenal results from the use of pelletized iron ore, many direct shipping ores, formerly considered high grade, are no longer desirable for furnace use, he continued.

Jacobs concluded, "If the iron mining industry in the U. S. is given assurance of reasonable treatment from local, state and Federal taxing authorities, and if it can see brakes applied to rising labor costs, I am confident that the iron ore mining industry will continue to grow. To the mining of iron ore is being added the task of beneficiation and agglomeration. These require new skills and different crude materials to start the process. The best, cheapest product, closest to the market will continue to be mined. Other less desirable properties will be laid aside until a future generation is motivated by forces comparable to those that provoked the present changes in our industry."

The aluminum industry, despite its current idle capacity of 500,000 tons, could enter a boom period "sooner than anyone has the temerity to predict," Walter L. Rice, president of Reynolds Mining Corp., told the Convention. Although aluminum shipments in the first half of this year were four percent below the same period last year, they have rebounded sharply and are now probably at an annual rate exceeding 2,500,000 tons. This acceleration should bring shipments for the full year to 2,450,000 tons, four percent over 1960, and approaching the all-time record year of 1959 when 2,480,000 tons were shipped. "Given a continuation of the business uptrend and the rebuilding of inventories that always accompanies an uptrend, tentative estimates place 1962 shipments at 2,900,000 tons," Rice said.

Three major problems face the coal industry, according to David L. Francis, president, Princess Coals, Inc., who discussed the solid fuels industry. They are: One, over-capacity; two, a fierce price struggle within the industry caused by a dual wage scale —union operators pay a dollar a ton more on the average than non-union operators—and three, problems of competition that are created by legislative or administrative rules which hamper the free flow of competition in this country and in the export market.

All is not lost by any means, though, Francis concluded. The tremendous and growing appetite of electric utilities for coal, coupled with an attainable expansion of existing coal markets in the medium and small steam plant fields, makes a remarkable period of revived growth in the coal industry entirely within the realm of reason.

The state of the industrial minerals industry was covered by Richard M. Foose, chairman, Department of Earth Sciences, Stanford Research Institute. Foose said that while industrial minerals have never held the same romantic appeal as metals, they have consistently grown in use and in value in all industrialized countries, and even a cursory view of them

in recent years creates a good deal more excitement and enthusiasm than a similar observation of most metals. In 1959, the most recent year for which complete figures are available, industrial minerals had a total production value of $3.7 billion. After reviewing the status of individual minerals in detail, Foose said that recognized economic factors point to a bright future for industrial minerals and their producers.

In winding up the session, S. H. Williston, executive vice president, Cordero Mining Co., reviewed the strategic metals. "It seemed impossible a year ago for the situation in the strategic metals industry to get much worse than it was," he declared. "It was then thought probable that one of the strategics which had been in continuous production in the United States for over 100 years might be able to survive. It seems less probable at the present time."

Williston ran down the list of strategic minerals and told the following story: The last major metallurgical production of manganese in the United States stopped in July. The only domestic chrome being mined is in Montana. Columbium production ceased a year ago. Western hemisphere cobalt production is confined to Cuba. Only captive mines can continue to produce tungsten in the United States at present price levels, and only insignificant amounts of by-product production of antimony is available domestically. So long as the cost of raw material is but a very small fraction of the cost of beryllium metal and alloy, there is little likelihood of any appreciable beryllium mining activity here, or abroad. In the past year seven domestic mercury mines have closed, leaving two running at reduced capacity, and only two running at capacity.

Williston concluded by saying that the metal consuming industries of the United States apparently are relying on military strategic stockpiles to supply raw materials in the event of an emergency.

TAX FORUM

ON WEDNESDAY, Lincoln Arnold, chairman of the AMC Tax Committee, presided over an all-day session of mining tax problems. Arnold, assisted by Brice O'Brien of the AMC staff, led discussion of tax developments during the past year and problems currently facing the industry. Legislative and administrative developments concerning the depletion "cut-off points" were given particular attention.

State Mining Association officials discussed industry problems at the 24th annual "Secretaries Conference"

Lawrence A. Adams, of American Potash and Chemical Corporation, spoke on the subject of allocating overhead between mining and non-mining costs. David Fernald, of the firm of Lybrand, Ross Brothers and Montgomery, presented a talk on the new regulations which determine whether persons engaged in a joint venture are taxable as a corporation.

URANIUM CONFERENCE

FOUR SPEAKERS PARTICIPATED in the afternoon Uranium Conference, which was presided over by John K. Gustafson, president, Homestake Mining Co., San Francisco. Scheduled to be first on the program was Rep. Wayne N. Aspinall of Colorado, chairman of the Raw Materials Subcommittee of the Joint Congressional Committee on Atomic Energy. Congressional commitments prevented his attendance, but his prepared statement was read to the audience.

Assuming that there will be no nuclear weapons requirement after the end of the current uranium procurement program in 1966, Rep. Aspinall's statement said, the uranium industry must look to atomic power for its market, for all other peaceful uses of nuclear energy require insignificant quantities of uranium.

He reviewed forecasts of the demands for uranium for nuclear reactors during the 10 years from 1966, which range from an annual average of 11,000 tons of uranium oxide down to one-seventh of that amount (current production is about 18,000 tons a year).

In the decade 1975–1985 a growth of atomic power in line with the larger estimate could occur, Aspinall stated. The addition of such a growth,

Speakers at the Uranium Conference discussed the post-1966 outlook: Lyman R. Fink, Mitchell Melich, Milton A. Pearl; seated, John K. Gustafson, Thomas B. Upchurch

The technical sessions covered a wide range of topics—all designed to bring mining men up-to-date on what's new in the industry. Shown above are the speakers on Exploration and Geology and on Management Tools and Techniques

he added, "would call for extensive exploration well in advance of 1975 if our domestic uranium industry is to have the capability of supplying these domestic requirements and be in position to meet expanding future requirements."

Thomas B. Upchurch, assistant director for procurement, Atomic Energy Commission, said that it is possible that forecasts of industrial demands for uranium in the post-1966 period could change, and that breakthroughs in technology could "revolutionize our entire thinking with respect to the application of nuclear energy." The Atomic Energy Commission is well aware, he stated, of the importance of the uranium industry and the problem of the post-1966 period. To date the AEC has made no decision as to whether there will be an AEC purchase program, he added, but studies by the AEC staff on the potential market based on a number of assumptions are already under way.

Dr. Lyman R. Fink, general manager, Atomic Products Division, General Electric Co., Palo Alto, Calif., estimated that by 1975 nuclear power generation could require as much or more uranium ore than current annual production. If this potential market is to be tapped, he said, the uranium producers and the nuclear industry must work together to lower the cost of atomic—electric power.

Dr. Fink pointed out that substantial technical and economic progress has been made by government. industry and the utilities working together. However, he added, economic improvements still required cannot be accomplished solely through continued technical advances in plant design and efficiency. The cost of uranium also must be driven down to spur expansion of the nuclear power market, he declared.

Mitchell Melich, president, Uranium Reduction Co., Moab, Utah, said that he does not believe that the Atomic Energy Commission will leave the uranium industry, and especially the entire atomic energy program, in a no-man's-land after 1966 because such action would be against the national interest.

As a solution to the industry's problem after 1966, Melich suggested that the Joint Congressional Committee on Atomic Energy and the AEC undertake studies to determine, in the national interest, what will be required to maintain the industry after expiration of the current program. Consideration should be given, he added, to a second stretch-out period from December 31, 1966, to December 31, 1970, in the procurement of raw materials. He also suggested that stretch-out contracts could include the deferment of some current uranium oxide deliveries into the post-1966 period.

EXPLORATION AND GEOLOGY

THE TECHNICAL PART of the program began Monday afternoon, following the Welcoming Luncheon, when a session on Exploration and Geology, under the chairmanship of Earl F. Cook, Dean, College of Mines, University of Idaho, got off to a good start as Thomas B. Nolan, Director of the U. S. Geological Survey presented a stimulating talk on "Importance of Research in Creating Mineral Resources." His remarks are printed in full in this issue on pages 88 to 92.

Willard C. Lacy, Professor of Geology at the University of Arizona, spoke on "Geological Developments in the Twin Buttes District Near Tucson." Four major copper orebodies have been developed in the Twin Buttes mining district in the last ten years—Pima, Mission, Palo Verde and Esperanza. The first three of these, Lacy pointed out, were discovered by inference from geological and geophysical data. The Esperanza deposit was a geological find, outlined on the basis of interpretation of alteration and leached capping. The area, he said, has received careful study by many geologists, with nearly as many interpretations as geologists, but continued exploration to test theories of localizing controls yields encouragement that additional deposits will be found.

Rollin Farmin, manager of mines, and Garth M. Crosby, chief geologist, Day Mines Inc., jointly prepared and presented a talk on "Extending Reserves in the Coeur d'Alene District." They pointed out that the district has produced nearly two billion dollars in lead, zinc and silver during the past 75 years, but stated that ore reserves usually have been insufficient for ten years' production. New discoveries, however, laterally and at depth, have kept pace with extraction. Geological studies since World War II, the speakers said, have come up with a better understanding of factors controlling the ore deposits and important new mines are still being found. Geologists in the district now expect the reserves of the future to come from the mineral belts rather than from the intervening, probably barren ground that was repeatedly cross-cut

by the early operators.

"Exploration Programs for Iron Ore, Lead, and other Minerals in Missouri" was the subject of a talk by Thomas R. Beveridge, Missouri State Geologist. Missouri is now experiencing the most intensive search in its history, he said, for mineral deposits in terms of dollars spent for exploration. Primary concentration of exploratory effort is for iron ore and lead. Beveridge observed that three iron ore deposits have been publicized but there have been other discoveries which are not well known, also that several lead deposits, aside from the new Viburnum mine in eastern Missouri, are being investigated. Beveridge appraised the future as very encouraging because of recent favorable indications in the Precambrian and the finding of major lead deposits outside the historical Lead Belt, where large areas are still to be explored by deep drilling.

Frank N. Spencer, Jr., manager-mining and exploration division of Cerro Corp., concluded the session with his talk on "Exploration at the Rio Blanco Project of Cerro Corporation." Held under option since 1955, the Rio Blanco mine near Santiago, Chile, was acquired by Cerro in 1960. The orebody is composed of chalcopyrite mineralization in altered andesite and is located in the Andes Mountains at 11,000 ft elevation. 120 million tons of 1.58 percent copper ore has been disclosed by development work which began in 1956. It is planned to mine the ore by the block caving method at a rate of 10,000 metric tons per day. The full construction program is expected to require five years, and will be undertaken upon completion of arrangements for financing the project and the granting of assurances by the Chilean Government regarding tax and exchange matters.

Peter Joralemon, geological consultant of San Francisco, assisted Dr. Cook as vice chairman of the session, leading the discussion periods following each talk.

MILLING AND METALLURGY

M. J. O'SHAUGHNESSY, assistant general manager, Nevada Mines Division, Kennecott Copper Corp., served as chairman of the first session on Milling and Metallurgy. Charles H. Curtis, assistant resident manager, Copper Division, Duval Sulphur & Potash Co., was vice chairman.

The first talk, entitled "Trends in Mineral Processing Research," was presented by Robert J. Brison, assistant chief, Materials Beneficiation Division, Battelle Memorial Institute. Brison stated that mineral processing research is following three apparent trends: (1) a more scientific approach to mineral processing problems, (2) closer cooperation with other technologies and (3) more emphasis on the application of automation. He said that the implications of these trends are that the mineral researcher will increasingly need a firm foundation in basic science as well as current information on conventional processes, and that mineral research laboratories will need the facilities and personnel for a science-based approach, together with ready access to the scientific knowledge and methods used in other technical fields.

"Automation and Electronic Control at the Copper Queen Concentrator" was discussed by Philip A. Allen, mill superintendent, Phelps Dodge Corp. Allen described some of the devices installed at the Copper Queen concentrator that have increased production efficiency and reduced costs. Among these are devices at the primary crusher that reduce wear on pan feeders, tally and record automatically the number of trucks dumped and the amperage load requirement for the crusher, and increase safety of men working in the dump pocket. Closed circuit TV is used to monitor the coarse ore bin. At the fine ore bins, an automatic tripper car distributes ore with minimum attention. Allen explained some unique features of the system for pulse feeding of reagents and told of such items as electronic bearing temperature alarms for ball mills, electronic fire alarm, capacitance type proximity switch for liquid level, and an information panel showing the activity status of crushers and ball mills. He emphasized that each installation has had to prove itself before another was considered.

The text of a presentation made by R. G. Edholm, manager, Industrial Products Planning, General Electric X-Ray, appears as an article in this issue beginning on page 51 that is entitled, "Application of X-Ray Emission to On-Line Control." The article was prepared in collaboration with W. F. Loranger, manager, Chemical Process Sales.

E. P. Cadwell, chief metallurgist, Mining Chemicals Department, American Cyanamid Co., spoke on "Recent Advances in Copper Concentration." After a brief review of general technological advances in treating copper ore, Cadwell mentioned some of the contributions to the industry by the chemical producers. Among these are developments in the use of flocculants in water clarification and filtration, and research to develop chemicals for producing higher grade concentrates in cleaner circuits. He concluded with a discussion of the maximum theoretical grade of concentrates versus the concentrate currently being produced at four operating properties in the Western Hemisphere, explaining that in some cases finer grinding is the answer while in others, grinding increases the problem.

W. R. Van Slyke, range metallurgist, Cleveland-Cliffs Iron Co., delivered a talk on "Heavy-Media Cyclones in Iron Ore Beneficiation." He mentioned that the history and development of heavy-media cyclones in treating Mesabi Range intermediate ores dates from 1947 and that they are currently used in 19 commercial plants on Minnesota iron ranges. He compared the present flowsheets with the original concept, discussed the reasons for changes in the flowschemes, and pointed out the areas in which further development and progress is desirable and necessary.

A second session on Milling and Metallurgy was conducted on Tuesday afternoon with E. M. Furness, vice president-operations at Reserve Mining Co., serving as chairman, and Dwight C. Brown, assistant director of research, Jones & Laughlin Steel Corp., as vice chairman.

A description of the first commercial application of the ACL Grate Kiln Pelletizing Process in the iron ore industry was presented by Daniel M. Urich, pyrometallurgist, Cleveland-Cliffs Iron Co. His paper was coauthored with Robert W. Berkhahn, operating metallurgist at Cleveland-Cliff's Humboldt mine. Urich showed the complete flowsheet of the operation from the primary crusher to the final stockpiling of pellets, emphasizing particularly the pelletizing plant. The start up, operation and maintenance of the Humboldt pellet plant has been very favorable, he said, and the quality of pellets produced has been exceptionally high.

C. A. Johnson, director of research, Hydrocarbon Research Inc., spoke on "Direct Reduction of Iron Ore by the H-Iron Process" and was assisted in his presentation by his coauthor, R. J. MacMullan, vice president of the same company. The H-Iron direct reduction process, which was developed by Hydrocarbon Research in collaboration with Bethlehem Steel Co., has been successfully demonstrated in two commercial plants, Johnson said. The reduction is carried out using finely divided ore in fluidized beds at tem-

Frank Coolbaugh, American Metal Climax, Inc., presided at the Safety and Health session. Shown are Glenn M. Hostetter, Herbert A. Wendel, H. J. Abbiss; seated, P. M. Wadsworth, Coolbaugh, F. R. Barnako

peratures below 1000° F and pressures above 200 psig. The low reduction temperature, he explained, was chosen to avoid stickiness of the iron powder, and high pressures are employed to simplify drying the reducing gas and to increase the rate of reduction. The product is an active powder that can be briquetted and passivated for safe shipping and handling; or alternatively the non-passivated powder can be charged directly into an electric steel furnace. An obvious advantage of H-Iron over scrap, he said, is its freedom from contamination by other metals.

"Columbia-Geneva's New Ore Testing Laboratory" was the subject of a talk by Milton F. Williams, manager of Columbia-Geneva's Raw Materials Lab located at Provo, Utah. His talk was well illustrated with slides showing the modern layout and excellent facilities for research on iron ores. coal, coke, and other raw materials of steelmaking. The laboratory's ultimate objectives, Williams said, are 1) to find ways to use these ingredients to produce high quality steels more economically, and 2) to conserve steelmaking raw materials by putting them to the most complete, efficient use. Projects now under study include concentration and agglomeration of iron ores, and blending of coal to produce the highest quality metallurgical coke possible from the types of coal available.

Erik Voldbaek, supervisor of Kiln Operations, Oregon Portland Cement Co., presented a comparison of cement manufacturing processes in this country with those of European producers. He showed that there has been a wide difference in the areas where the two groups have concentrated on reducing costs. The trend in Europe has been to reduce fuel and power costs, while in America reduction of labor costs has received the greatest study. In general, he observed the American quarries are more mechanized than the European, but the methods and equipment used are very much the same. As to processing, he said, the Europeans prefer the dry process because of its low fuel consumption, and they have developed appropriate systems for drying, grinding and homogenizing the ground material together with different heat-exchanging kiln designs. The air-swept compartment mill is the most common type of finish mill used in Europe and is now being built with outputs of 450 barrels per hour, he reported, and air separators in closed circuits are used for grinding cement types with higher fineness.

Frank H. Day, general superintendent of The Anaconda Reduction Dept., in his paper, "Disposal of Metallurgical Wastes at Anaconda," discussed the handling of reverberatory slag, flue gases and flue dust, mill tailings, and the effluent from a precipitating plant. He described a Fluo-Solids roasting plant, now under construction, which will remove arsenic from the SO_2 gas in scrubbers prior to the manufacture of sulphuric acid. After reviewing past practices of tailings disposal, he described a recent construction project which included a 75-ft hydro-separator, a 370-ft thickener, a 40,000 ft sand pipeline, and a tailings dam which will eventually allow storage for over 400,000,000 tons of tailings. Lastly, he told of the method used in treating the effluent from the mine water precipitation plant. This includes neutralizing the fluid, reducing its iron content, removing suspended solids, and making it suitable for discharge into a natural drainage area.

SAFETY AND HEALTH

ANOTHER HIGHLY SUCCESSFUL AMC Session on Safety and Health was held on Tuesday morning, under the chairmanship of Frank Coolbaugh, president of American Metal Climax Inc.

"Uranium Operators Safety Council in the Grants Area" was the subject covered by John Abbiss, safety director, Homestake-Sapin Partners. He told an intent audience about the Lake Ambrosia Operators Safety Council, organized in the early part of 1960 to delve into the reasons for the fatalities and serious accidents that were occurring in that district, and to take the necessary remedial action. The Council has been highly successful from the beginning and has been responsible for a long list of safety activities which have reduced accidents and made the Lake Ambrosia field a safe working area.

Herbert A. Wendel, chairman of the Bureau of Safety at The Anaconda Co., discussed the use of incentive awards for safety, explaining the need for safety promotional activities which will create and maintain improved interest and cooperation on both front-line supervisory and employe levels. Wendel stressed the need for coordinating and promoting incentive award plans along with all other phases of a progressive, comprehensive program involving training, education, participation, communication and enforcement, at all management, supervisory and employe levels.

F. R. Barnako, manager, Compensation and Safety Dept., Bethlehem Steel Co., in his paper on the "Safety Program of Bethlehem Steel Co." described the background and purpose of his company's safety program and emphasized that a single program is applicable to all the company's diversified operations. The basic philosophy of the company is that safety is not a separate endeavor, but is an integral part of production. Among the basic fundamentals of safety on the job, as related by Barnako, are good housekeeping, job safety analyses, personal safety contacts between supervisors and workers, first aid training, a broad medical program and safety codes. A good safety program, he said, includes participation in established safety organizations and certain voluntary organizations of in-

One of the Open Pit Mining sessions was conducted by Carl G. Hogberg, president, Michigan Limestone Div., U. S. Steel Corp.

dustry groups. Barnako also pointed out that his company has found it beneficial to direct a phase of its program to safety of employes away from work.

In a talk on "Hidden Costs of Accidents," Glenn M. Hostetter, supervisor of safety at Erie Mining Co., observed that authorities on the indirect costs of accidents, through the years, have indicated that these costs are in the neighborhood of four times the direct costs. He went on to tell how his company has, in the design and operation of its taconite plant, been able to reduce the indirect costs of accident potential to a minimum. This, he reported, has been done by the duplication of equipment at critical points, by the use of modern fire fighting equipment at critical locations, and by rigid inspection of material handling and other equipment. "In the final analysis," he said, "you must prevent accidents to reduce the hidden costs of the accidents."

P. M. Wadsworth, safety director at Climax Molybdenum Co., stressed the importance of "Job Hazard Analysis" and how its application can improve safety programs. He described three main procedures of such analysis as: collecting the necessary statistics, analyzing these statistics, and then making use of the information. He went on to describe in detail the forms and methods used by his company in handling this information, and in conclusion, he suggested corrective measures that might be necessary to improve safety performance as indicated by the analysis.

OPEN PIT MINING

ON TUESDAY MORNING, Carl G. Hogberg, president, Michigan Limestone Division, U. S. Steel Corp. presided at the first of two sessions on Open Pit Mining. Assisting as vice chairman of the session was O. E. Pothier, director of mining operations, J. R. Simplot Co.

In a talk entitled, "Effect of Fragmentation on Crusher Performance," James R. Carr, assistant mine superintendent, National Lead Co., said that in hard rock mining operations, the degree of fragmentation in blasting is the one most important factor in crusher performance and costs and can greatly influence the combined cost of the entire size reduction process. At his company's MacIntyre development, Tahawas, N. Y., in 1960, crusher performance was increased 23 percent over 1959 figures as a result of changes in drilling and blasting practices. Based on previous fragmentation standards, a capital expenditure of over $1,000,000 would have been required to obtain a similar increase in crusher capacity. In addition, Carr said that in 1960 combined drilling, blasting, dropball and crushing cost was the lowest in the operation's history.

Hugh H. Bein, manager, Sand Division, Del Monte Properties Co., described a "New Source of Silica for the Pacific Northwest." This is the Lane Mt. Silica Co. operation in Stevens County, Wash., which produces silica sand for the glass foundry industries of the Northwest. Discovered in 1958, the deposit ranges from almost unconsolidated sands to a true hard quartzite, Bein said. It is worked by ripping, and loosened material is bulldozed to a loading area for transfer into trucks by a front end loader. A newly completed processing plant nine miles away incorporates a 100 tph crushing section, attrition-scrubbing, flotation, cyclone and classifier washing and rotary drying facilities.

A report on "Recent Developments in Open Pit Haulage," was given by E. R. Borcherdt, partner, Borcherdt & Smith, San Francisco, in which he commented that operators are finding that lower haulage costs can be gained with larger trucks, and that this applies to both straight dump trucks and tractor-trailer units. He told of experience at the Berkeley pit with electric trolley-diesel trucks for operation on 15 percent grades. Reserve Mining Co. expects to add six 85-long ton capacity tractor-trailer units to its truck fleet on the basis of performance of an experimental unit. He also described developments at the manufacturer's level, including an off-highway wagon train, redesign of a 35-yd truck to increase capacity 20 percent, a newly developed bucket to minimize dipper spillage, and truck tire improvements.

"An Open Pit Application of a Digital Computer," was the subject of a talk by James F. Olk, mine superintendent, Pima Mining Co. He told how Pima applied computer methods to a mine expansion, stressing the logic and methods used in setting up a program and obtaining a solution. The expansion area was divided into small segments and the information for each segment arranged, along with costs and other data, so that the computer calculated the ore and waste tonnages, and not the value of the ore, outward from the existing pit until an economic point of expansion was reached. Olk emphasized that because of the cost of setting up the computer program, no savings were realized in solving the problem in this way for the first time, but that subsequent problems could be solved easily, since only the assembly of data would be required.

Craigmont Mine Ltd. is placing its copper mine near Merritt, B. C., in operation this fall at an initial production capacity of 4000 tpd, according to Robert Hallbauer, mine superintendent, who described "Open Pit Methods at the Craigmont Mine." Under development for about two years, some 8,000,000 tons of 1.8 per-

cent copper-ore will be mined by open pit methods, although the larger portion of the ore body will be mined underground. The pit is located on a side hill and the altitude of the ore zone is such that the pit is open at one end for a large portion of its depth. Initial production will come entirely from the open pit, but underground mining will begin after about one year and gradually assume more importance.

A second session on Open Pit Mining was held on Wednesday afternoon with J. B. Pullen, assistant general manager, Western Operations, Phelps Dodge Corp., serving as chairman. C. V. O. Hughes, manager, Mining Division, Virginia-Carolina Chemical Co. was vice chairman.

The first talk of the session, "New Applications of Explosives," was presented by H. E. Farnam, Jr., manager of operations, Iron Ore Co. of Canada. Farnam said that the mining industry still has much to learn about the problems of how to use recently developed explosives more efficiently. Among the problems are those concerned with stemming of powder columns, proper coupling of the explosives to the borehole, and how to properly distribute explosive energy. He described blasting practices at Iron Ore Co. of Canada, and discussed some new theories for proper application of explosive energy. As a result, in the last two or three years the company has increased broken rock yield by 30 percent per foot of drilled borehole, reduced blasting cost 40 percent, decreased blasting frequency, improved drilling accuracy, reduced explosives handling cost, and improved safety and fragmentation.

F. D. Bickel, consulting engineer, Wilmington, Del., spoke on "Developments in Taconite Blasting at Erie," stating that, at Erie Mining Co., blasting represents the largest single item of production cost. This is due to the extreme hardness of the ore and large quantity of crude material that must be mined to produce a pellitized product. Experiments at Erie over the past three years have led to the use of low-cost, free-running blasting agents for column loading, which reduces blasting costs and actually produces better fragmentation. Top breakage is improved by building up the charge high in the hole, Bickel said. He also stated that secondary blasting, formerly a high cost item, has practically been eliminated through better techniques.

"The Story of Atlantic City" was the topic of a paper presented by A. S. Henderson, process development engineer, and prepared by W. F. Pruden, chief engineer, both with Columbia-Geneva Steel Division, U. S. Steel Corp. Henderson told about the various facilities for mining, concentrating and agglomerating ores at Atlantic City, Wyo., which will be the site of the first integrated iron ore beneficiation plant west of the Mississippi. Ground was broken for the project on June 30, 1960 following engineering studies begun in 1956. The ore body to be mined is 4000 ft long, averages 800 ft in width and dips 85° east, with depth as yet undetermined. The two classes of ore —prime and oxidized—will be mined in two phases, the first of which will be removal of the oxidized ore over the next six years. For the remainder of the mine's life, the prime ore will be mined. Conventional methods will be used, including truck haulage on 25-ft levels with 37½-ft safety berms left on every third level. Average over-all pit slope will be 45°.

R. K. Barcus, assistant general manager, San Francisco Chemical Co., described a "New Phosphate Operation Near Vernal, Utah," which has proven reserves of over 700,000,000 tons averaging just under 20 percent P_2O_5. Barcus commented on the occurrence of western phosphate rock and the factors that led up to development of the Vernal deposit by San Francisco Chemical. Rotary drills are used for drilling both overburden and ore. Waste is hauled only far enough to clear the ore. With careful management, the waste haul can be limited to a maximum of 1000 ft.

California Salt Co. practices "Open Pit Mining of Rock Salt" at Bristol Lake, a playa saline deposit in the Mojave Desert region of southern California and produces about 300,000 tons per year, according to Adolph V. Mitterer, plant manager at the operation. He said that the deposit has been in production since 1909 and that it is a major source of sodium and calcium chloride in Western United States. Overburden is stripped off with draglines to expose the salt bed which ranges from a few inches up to 10 ft in thickness. Stripping ratios are about two to one, but are increasing as favorable parts of the deposit are mined out. The salt is broken by drilling and blasting. It is loaded by dragline into ten-ton rail cars for transportation to the mill. where it is processed by crushing. washing and screening operations.

UNDERGROUND MINING

THE FIRST OF two sessions on Underground Mining was held on Tuesday afternoon with A. R. Patterson, vice president and general manager of Knob Hill Mines Co., and A. B. Bowman, vice president and general manager of Banner Mining Co., serving as co-chairmen.

George K. Biemesderfer, geologist, and Reinhold H. Leske, mining engineer, Grace mine, Bethlehem Steel Co., collaborated in preparing a talk on "Ground Water Control at Grace Mine," which appears as an article on pages 39 to 44 of this issue.

"New Automatic Friction Mine Hoists" was the subject discussed by Carl W. Anderson, assistant to chief engineer, The Hanna Mining Co. Anderson described the first American-made automatic friction mine hoists, which are installed at the Homer-Wauseca mine operated by The M. A. Hanna Co. This mine is a combination of two properties using a common hoisting shaft in which the mine products are kept separate throughout the entire materials handling system. Two friction ore hoists and one friction cage hoist comprise the system. Each ore hoist incorporates a 149-in. diam friction wheel and 700-hp d-c motors, with provision for fully automatic skip-loading and hoisting. Semi-automatic cage hoisting is achieved through operation by push-buttons at the various level stations. The system features some of the latest control concepts and safety devices.

John Suttie, mine superintendent, The Anaconda Co., told about "Raise Driving at Anaconda," in a talk that was prepared jointly with Leonard P. Colvin, assistant research engineer. Suttie said that widespread use of hydraulic fill in Butte has to a great extent eliminated the need for large cross-section timbered stope raises—that a single compartment raise can be used for all the essential services. This has made it possible to drive untimbered stope raises by mechanized methods using raise climbing devices. Double shifting of mechanized raises is now possible as opposed to the previous practice of single shifting in the traditional timbered raise, with the result that the new raises have been completed in one-third the time formerly required, and over-all costs have been cut 30 percent. Another rasing method being investigated involves drilling a raise round pattern of holes down from one sill to the level below and blasting the holes in lifts. It is hoped that this method can be applied to veins where uniform dip is indicated.

The need for proper wire rope spooling was the theme of a talk by

Lonnie Thompson, chief sales and service engineer, LeBus International Engineers, Inc., as he discussed "Wire Rope Spooling, Method and Practices." He covered the three basic patterns of spooling wire rope—helical spooling, single crossover parallel spooling, and double crossover parallel spooling—as well as plain drum and grooved drum spooling. The functions of the grooved drum are to set the pattern by which the rope is spooled, to set the pitch for all the wire rope to be spooled upon, and to support the initial layer of rope.

William R. Barber, Jr., manager, Metallurgical Department, Esco Corp., described "Special Cast Alloys for Underground Use" that can yield dividends through lower maintenance and replacement costs. Modifications in composition and heat treatment of four well-known alloy series—highly hardenable low-alloy steels, austenitic manganese steels, highly alloyed irons, and corrosion resistant alloys—are providing important combinations in high strength, impact resistance, abrasion resistance and ductility, according to Barber. He described recent developments in the metallurgy of cast alloys and discussed applications in scrapers, dipper teeth, grizzly bars and screens, chute liners, mine car wheels, and pump and valve parts, noting specific advantages and disadvantages of some presently used materials.

Wednesday morning, the second session on Underground Mining was held under the chairmanship of Earl H. Miller, resident manager, U. S. Borax & Chemical Corp., with C. L. Pillar, mine superintendent, San Manuel Copper Corp., serving as vice chairman.

Three variations in the "Use of Ammonium Nitrate Explosives Underground" were discussed by Robert P. Matson, mine superintendent, Midwest Ore Co. At Cleveland-Cliffs Iron Company's Cliffs Shaft mine, a pneumatically placed ammonium nitrate-fuel oil mixture is used for blasting throughout the mine, with the exception of a few wet bottom holes. Matson stated that fragmentation has been as good or better than with dynamite and that total explosives costs have been reduced 30 percent. At Cleveland-Cliffs' Maas mine, AN-FO is being used in 2¼ in. long-holes up to 80 ft in length and under 45° in a modified sublevel stoping operation employing ring drilling. It is also being used in drift rounds. Midwest Ore Co. by June of this year had converted to almost 100 percent usage of an AN-FO blasting agent. In all three operations, results have been good, fume characteristics have been well within allowable limits, and appreciable reductions in explosive costs have resulted.

Floor discussion added much to the sessions

A. G. Stirling, operating superintendent, Consolidated Mining & Smelting Co. of Canada, Ltd., told about "Underground Concreting Practices—Sullivan Mine." The present mining method at the Sullivan mine comprises a blasthole and scraper drift system. Stirling said that the largest single use of concrete is for lining the scraper drifts. Reinforcing is not used, but steel channels and timber are placed in drawhole brows to serve as bumpers. A four to one mix is used in all concrete work and water content is kept slightly above standard to make it flow more easily into closed forms. It is blown in five cu ft batches for distances up to 2000 ft. He commented on the use of gunite for ventilation seals and for back support in drifts, hoist rooms and crushing chambers.

"Use of A-C Shuttle Cars at Carlsbad" was the title of a talk by D. F. Parker, maintenance superintendent, National Potash Co. In the general picture, there is little difference between a-c and d-c shuttle cars, he noted. The primary advantage of a-c power is in the application of the induction motor, which rates low in maintenance, is rugged and is relatively easily designed into various shapes required in mobile equipment. High starting torque of the induction motor, though, makes it necessary to design the shuttle car drive system so as to compensate for shock transmitted as a result of rapid acceleration. The fact that a-c power can be economically and conveniently changed in voltage level gives it a considerable advantage in mining operations. This becomes evident when the power needs are reduced to one source.

James W. Clark, manager, Mining Machinery Division, Lake Shore, Inc., spoke on "New Trends in Underground Rail Loading and Tramming." Remarking that developments in underground rail loading and tramming have generally been slower than those in the conveyor and shuttle car fields, he stated that recent advances have encouraged some mines to switch to cars. Among these advances are new sectionalized track laying techniques, improved mine car design resulting in bigger payloads, increased stability, reduced rail and wheel maintenance, automatic loading and dumping systems, greater tramming speeds, and automated over all control systems.

The last talk of the session concerned a $30,000,000 potash project in southeastern Utah which was reviewed by Frank Tippie, resident manager, Texas Gulf Sulphur Co. in a talk entitled "Texas Gulf Sulphur Company's New Potash Project," prepared jointly with C. F. Fogarty, senior vice president of the company. Tippie described the project as being one of the most significant developments in the Nation's mineral industry today. The company is sinking a 22 ft inside diam concrete-lined shaft that will be 2800 ft deep upon completion and will have a capacity for hoisting 12,000 tpd of ore. The mill is designed and being built in 4000 tpd units, the first of which is sched-

uled to be in operation by the end of 1962. By the 1964–65 potash season, Texas Gulf expects to be marketing at the rate of 1,100,000 tons of muriate per year.

MAINTENANCE SYMPOSIUM

EDWIN C. DEMOSS, manager of Iron and Coal Operations, Utah Construction & Mining Co. and Donad M. Chisholm, associate general manager, Lake Superior Mining Division, Pickands Mather & Co., served as co-chairmen at the Maintenance Symposium on Wednesday morning.

Henry R. Burch, assistant general manager of the Anaconda operations at Weed Heights, Nev., presented a talk on "Preventive Maintenance Program at Weed Heights," for A. E. Millar, general manager of the operation. Basing his remarks on the premise that a good maintenance program must be planned, Burch said that the service departments at Weed Heights achieve this by keeping a proper filing system on all equipment, thus assuring that it is serviced at regular intervals and that unscheduled shutdowns are prevented. A part of the truck maintenance system at the operation is to keep close watch on the costs of seven component parts of the entire haulage fleet, rather than on each truck. Thus the per hour cost of repairs for engines, transmissions, etc., is known as a percentage of total costs. Preventive maintenance is stressed throughout the operation, extending to the electrical equipment, shovels, beneficiation plant equipment, and the FluoSolids plant.

"The Use of Computers in Equipment Analysis" was discussed by E. R. Drevdahl, associate professor of Mining at the University of Arizona, who pointed out that the introduction of high-speed computers makes it possible to develop complex mathematical expressions which simulate complete mining operations, and that it is necessary to give more consideration to the planning and engineering of equipment systems to accurately establish these mathematical expressions. With a computer it is possible to determine what combination of machines will give the best results, without making a number of theoretical comparisons. Through habit, Drevdahl said, we have naturally tended to limit our thinking in terms of our computational ability, and we must now re-evaluate our situation in terms of this new computing tool, just as must be done when any new equipment is developed. He concluded by saying that the computer is just a tool and its results will be only as good as the efforts expended in its utilization and the ability of the personnel doing the work.

O. C. Madsen, division comptroller, Utah Copper Division, Kennecott Copper Corp., in his talk, "Planning for Mature Inventory Management," dealt with new techniques for projecting inventory requirements and the developments of a systematic plan embodying certain standards, facilities, procedures and controls. The spiral of ever increasing automation in mining, he said, has brought with it a corresponding spiral in the complexities of inventory management. To meet the ever-mounting volume and variety of materials and supplies carried and the alarming amount of capital tied up in spare parts inventories, Kennecott embarked on a program for streamlining and tightening inventory control, based on the philosophy that investment in material and supply inventory be at a minimum consistent with sound operational requirements. The company formulated and placed into effect a plan which called for: setting standards, providing facilities for storing and handling material and processing data, adhering to prescribed procedures of record keeping, and setting up controls to make sure the system is functioning properly. Further steps toward mature inventory management, Madsen said, are being sought through planned production and preventive maintenance, and through new techniques for projecting inventory requirements.

In his talk on "Lubrication of Mining Equipment," Robert C. Cuffel, technical specialist for Standard Oil Co. of California, asked that mining men charged with purchasing and maintaining mining equipment investigate their own buying habits. He pointed out that if equipment owners are to realize maximum equipment life, and if they expect to lubricate this equipment at minimum cost, they must purchase the right quality products and put them in the right place, at the right time, and in the right amount. He warned against substituting low priced products for quality, or reducing the correct frequency of lubrication.

LeVern M. Griffith, manager of plant services at The Bunker Hill Company, described his company's plant services program which was organized in 1955. He traced many of the complex problems which the plant services division faced in a complete reorganization of the company's Kellogg operations. This involved completely revising accounting procedures and systems to accumulate, distribute, and report costs by units of responsibility and product. Griffith described the cost control methods and systems which were developed and showed how cost information is processed in order to quickly provide special reports for cost analysis. It was his conclusion that the results in reduced unit costs of products is assurance that the program is paying off in dollars saved on maintenance and services.

MANAGEMENT TOOLS AND TECHNIQUES

NELSON C. WHITE, vice president of International Minerals & Chemical Co. presided over the Wednesday afternoon session on Management Tools and Techniques. He was assisted by Benton Boyd, assistant to the vice president, U. S. Smelting Refining & Mining Co. who served as vice chairman.

"Research and Development in an Unfavorable Economic Climate" was the subject of a talk by Stanley D. Michaelson, chief engineer, and prepared jointly with Stuart R. Zimmerley, director of the Kennecott Research Center, both on the staff of the Western Mining Divisions, Kennecott Copper Corp. The talk stressed the need for the domestic mining industry, like other industries, to join in the technologic race for economic survival. The search for cost advantage through new methods, and the adoption of improvements developed in other industries, Michaelson said, entails research, development and engineering. He described the principal areas where these skills are needed in mining companies and cited examples of profitable applications of these phases of technology to organizational practices, mining, metallurgical and metal marketing. He also indicated areas where further work is needed. The authors' basic premise was that mining companies must take the initiative in research and engineering development work whether or not outside aid is tendered the industry. They suggested several means of carrying out the proposed research and development work for the smaller and medium sized mining companies.

Richard M. Stewart, director of mining research at the Anaconda Co., in his talk, "Industrial Engineering and Research in Mining," observed that a good manager establishes objectives, policies, and procedure for his area of responsibility, and then he delegates the operation of the vari-

ous work centers to his staff. Industrial engineering and research, he said, assist the manager in establishing engineering controls on people, supplies, and equipment to stress the need for management staff personnel to establish measurement techniques, study alternatives in seeking the best solution to a problem, and seek entirely new approaches to the problem. With the expanding technology available to us today, he said, there is unprecedented opportunity for improvement in the mining industry.

"The Role of the Psychologist in Management" was presented by Robert O. Shaffer, partner, Rohrer, Hibler & Replogle, consulting psychologist firm in Chicago. He told his audience what contributions psychologists have made to the industrial scene and how they might be used in the mining industry. He pointed out that the psychologist is a relatively new tool for the modern manager, to be used—like a legal counsel, auditor, or mining consultant—as a specialist who enriches the manager's judgment. Besides telling what psychological consultants are and can do, he made some direct statements as to what they are not, and what they can't do.

In his paper, on "Systems Analysis Applications in the Mining Industry," Clarke K. Olson, mining instructor at the Michigan College of Mining and Technology, observed that the mining industry seems to be lagging in the use of systems analysis in which mathematical and statistical models can be used to help solve economic management problems. By making more use of these tools, Olson said, the industry would increase the efficiency of operations and put decision making on a more objective basis. Throughout his talk Olson stressed the need for giving the mining engineer adequate knowledge of systems analysis to qualify him to become a working member of an operations research team, along with a man specialized in the mathematics of computer work. The experience, intuition, and practical knowledge of the supervising engineer, he said, is indispensable in constructing and evaluating the applicable model. It is more feasible, he concluded, for the engineer to pick up a working knowledge of the necessary mathematics involved in systems analysis than for the mathematician to grasp the real situation posed in mining problems.

GENERAL OPERATING DEVELOPMENTS

SEVERAL INNOVATIONS IN engineering and mining techniques were discussed at the General Operating session held Wednesday afternoon under the chairmanship of Thomas B. Douglas, vice president, Ideal Cement Co. Hercules C. Pappas, executive staff assistant, Raw Materials Division, Aluminum Company of America, served as vice chairman.

Edmond E. Chapus, Sogreah, New York, presented a paper on the "Transportation of Solid Materials by Pipeline" co-authored with Elie Condolios, Grenoble, France. Chapus said that hydraulic transportation of solid materials has been practiced for some time, but has not yet been widely accepted by industry. Part of this reluctance can be attributed to the lack of information on basic laws and design criteria involved in hydraulic transportation. After briefly discussing laboratory experiments, backed up by field installations of several hydraulic transportation systems in Europe, Chapus said that sufficient knowledge is now available to allow a quick evaluation of the merits of any hydraulic transportation system and that the system can be engineered soundly.

With the maintenance and operating costs of a piece of equipment running as high as 20 times the original cost, there is considerable margin for reducing mining costs by designing a machine to increase operator efficiency and reduce maintenance, according to John W. Wulfeck and Lawrence R. Zeitlin, Dunlap & Associates, Inc. In a paper entitled "Designing Mining Equipment for Human Operation," and presented by Zeitlin, the authors said that too little emphasis has been given to the role of the machine operator when designing a machine. It is not enough to equip a machine with all kinds of motions and then just bring controls to a common place. The ability of a man to operate the controls efficiently must also be considered. The fund of knowledge on human behavior is now such that equipment design engineers can build increased efficiency into a machine by drawing on this fund.

A. C. Holen, plant engineer, Northwest Magnesite Co., said that automation of a five mile long aerial tram at Northwest Magnesite has made possible a savings of 83 percent in labor alone, and improved the overall operation. The tram carries 215 buckets, each having a capacity of 1200 lb, and travels at a rate of 500 fpm. Buckets are spaced every 265 ft. Before automation it took six men per shift to operate the tram—since the automation program has been completed, only one man is needed. Other benefits that have accrued to the company are: decreased maintenance, less downtime, and improved safety.

A panel on grouting for control of ground water concluded the session. Panel participants included Lionel A. York, mining engineer, Cementation Company of America, Inc., John J. Reed, professor of mining engineering, Colorado School of Mines; and Victor L. Stevens, manager, Mining Division, Boyles Brothers Drilling Co.

After giving a brief outline of the history of grouting, York said that "in recent years there have been interesting developments in the field of chemical grouting." He used several case histories to show the application and success of various types of grout, and concluded with a brief discussion of pre-cementation for shaft sinking—that is, completing the entire grouting operation before the shaft is started. Pre-cementation has been used in South Africa to depths of 4000 ft and has proved economical. In certain instances shaft sinking delays, caused by grouting in the shaft bottom during sinking, have been reduced by as much as 70 percent.

Reed said that most mining companies are faced with the problem of grouting at one time or another, but few companies are large enough, or are faced with the problem often enough, to maintain a crew of grouting specialists who are on the job continuously. However, he emphasized, it is desirable to maintain a specialized department, or at least a specialized group of work crews and supervisors, who can work with equipment designed especially for the job, and whose experience and education will develop and accumulate. He then outlined a program that could be followed to obtain these ends, and concluded that grouting should be looked upon as an engineering science rather than a mining art.

In discussing the place of chemical grouts in ground water control, Stevens said that they are not a material to replace cement or other grouting materials, but rather to supplement them. Materials for chemical grouting cost more, but this factor is off-set by a saving in grouting time. Chemical grouts are particularly valuable where the ground to be grouted has uniformly fine openings. In fissured or fractured ground, however, it is most effective to use cement or other grouting materials to first plug the larger channels, and then to follow with chemical grout if needed.

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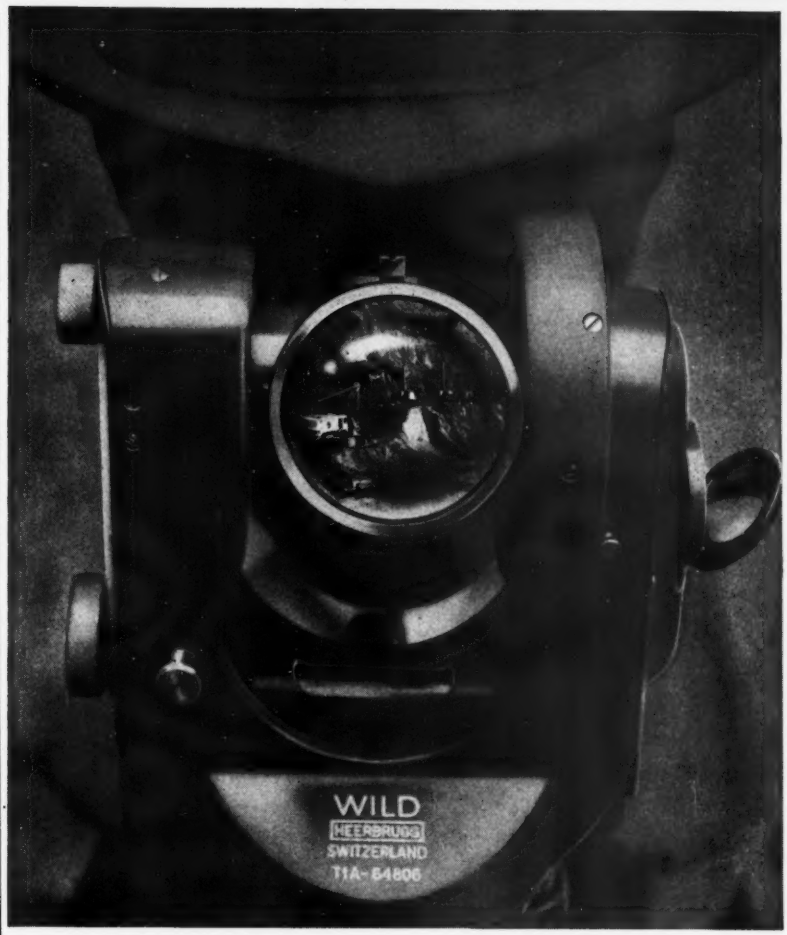

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At this Maryland quarry, Ammodyte,® a low-cost cartridged explosive, was used to obtain maximum fragmentation and displacement of this tough, blocky granite gneiss. In the large photo above, notice how the toe is sweeping clear, resulting from well planned bottom initiation with Rockmaster® millisecond delay electric blasting caps. The resulting muck pile is properly laid out for easy, efficient digging.

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ATLAS EXPLOSIVES

A reliable authority has stated that most firms could reduce their maintenance costs 25 percent or more through stepped-up efforts.

Chemstone Corp. is a part of 75 percent of American industry which is directing special attention to maintenance cost reduction. At its operations in Virginia the company has stepped up its efforts and is making headway against the tide of new equipment getting older and increasing labor and material costs.

At Strasburg last year, Chemstone operated four shovels, eight 18-ton trucks and four 27-ton trucks on a two-shift basis. Six blasthole drills were operated three shifts. Approximately 3,000,000 tons were trucked out of the quarry. The plant also operated crusher and screening equipment, a lime plant consisting of four shaft kilns and a hydrator. An aggregates plant and a fine grinding plant were operated part time, and several new construction projects were completed during the year.

Maintenance accounting records provide historical and cost detail information and are effective in spotlighting points for cost reduction. They provide the tools for planning and scheduling work in a preventive maintenance program. Here a four-yd shovel loads overburden into a 27-ton end-dump truck at Chemstone's Strasburg quarry

By JOHN G. WARNER
Plant Manager
Chemstone Corp.

Maintenance at the Operation

Worthwhile results can be achieved if management will direct as much effort to the reduction of maintenance costs as it does to the reduction of production costs

Maintenance Performed on Organized Basis

Substantially all maintenance work and all kiln refractory repairs were handled by plant personnel. Some major repairs were accomplished in the outside shops, which accounted for six percent of the total maintenance costs. For the entire operation, the ratio of costs of maintenance materials and supplies, including tires and refractories, to maintenance labor was four to one.

With the crash type of operation conducted during 1960, which has recently been eased, there was, and still is excellent opportunity for maintenance cost reduction. Certainly the company's maintenance has been placed on a more highly organized and formal basis, with a gradual change from the extreme of "fixing when it stops running" to much discussed preventive maintenance.

Maintenance cost reduction is rightfully receiving more recognition and is becoming increasingly important. The ratio of production employes to maintenance employes is now about one-half of what it was 20 years ago on a national basis. With business becoming more competitive, costs must move into cutting of muscle instead of fat and blubber. Maintenance management procedures and controls directed to such cost reduction again becomes all the more significant.

When higher level management recognizes and directs as much interest, talent, ingenuity and application of modern scientific techniques to the reduction of maintenance costs as they do to production costs, surprising and worthwhile results can sometimes be achieved—part or all of the 25 percent cost reduction mentioned earlier may be realized.

Economic Conditions Affect Maintenance

Maintenance thinking by management, however, does vary—and it varies with current economic conditions. Especially when business is good, there is the tendency to squeeze out every ton and run to complete

The equipment operator is a vital link in preventive maintenance. At Strasburg, the operator notes mechanical items on his shift report. For this reporting function to be most effective, it is essential that the operator receive action after noting a mechanical deficiency, whether true or suspect

failure. There is a natural reluctance to interrupt any operation for preventive maintenance. When business is poor, each expenditure receives closer scrutiny and often maintenance is minimized to reduce cash flow. It is usually an exception where money can be saved by breaking down instead of shutting down.

An article in a well-known financial paper reported that one firm was saving money by replacing light bulbs on a schedule instead of waiting until they burned out—an extreme example of cost reduction by preventive maintenance. But 75 percent of American industry is undoubtedly right in its increased efforts toward cost reduction by preventive maintenance.

Organizationally, maintenance is frequently regarded as a service department, but the author believes that it becomes more effective when functioning in line organization parallel to production. Its performance should be evaluated in terms of costs, productivity, equipment lost time, and inventories as related to standards, much the same as production is evaluated. This helps inspire a competitive spirit which is a spark plug to cost reduction programs.

Quarrying is not a glamour business, and there are no glamour shortcuts to maintenance cost reduction. Only through hard seeking and diligence will this be accomplished.

There are many approaches to setting up maintenance organizations, systems and procedures and preventive maintenance programs. Each should be tailored to the nature of the individual operation, its facilities, and personnel. The size of maintenance force, personnel skills, accounting and stores facilities, operating demands and schedules, and types of equipment obviously must be considered in the development of the most effective maintenance systems and procedures.

Accounting Records Aid in Cost Reduction

Quarrying at the Presque Isle Corp. at Alpena, Mich., is a seasonal operation, subject to the Great Lakes shipping season. There, all possible major repair work is scheduled for the winter months when the plant and most equipment is idle. In Virginia, Chemstone Corp. operates 12 months a year, notwithstanding a record 72-in. snowfall last winter.

It is probably safe to say that the majority of maintenance management and supervisors operate to a large extent by the seat of their pants. They depend on: 1. Judgment, 2. intuition, 3. memory, 4. outguessing a piece of machinery, and 5. scattered notes. This is normal and essential to a maintenance operation, but especially when efforts are directed to preventive maintenance, the details and cold facts that some form of cost and maintenance history records provide are lacking. In an operation of any size at all, it is important to have some form of maintenance accounting record system for historical and cost detail analysis. After the system is established, it must then be used to yield returns.

While records are partly historical, they are effective in spot-lighting points for cost reduction. They provide tools for planning and scheduling work in a preventive maintenance program. These records are basically those for plant operators, and the details do not generally concern financial personnel except for their contribution and participation in the system.

There are many operations that employ accounting and maintenance record systems from simple manual record-keeping, to automatic bookkeeping and the application of electronic computors with memory and programming inputs for historical records, planning, inventory control—actually there is hardly a limit as to what can be provided.

Records Serve as Stimulus to Maintenance Personnel

The author was fortunate at one time to have had the opportunity to set up maintenance records and systems which were integrated with IBM accounting. At the outset, there was considerable resistance to the paper work by the maintenance force. After a year or so maintenance foremen were also thinking of maintenance in terms of dollars and, on their own, studied the records, plotted curves and took great pride in showing where cost reductions had been made. They took pride in seeing availability or "on stream" factors increase in face of lower maintenance costs. You can't eat the whole elephant at once; slice him to pieces. Records give you the pieces to chew on. They can have real psychological impact to inspire maintenance personnel to extend extra efforts to see a cost go down.

Chemstone's Virginia operation is small. Its systems are simple and in the formative stages. Substantially all the record keeping is an accounting department function.

Procedures are required for the smooth flow of information which, as in most operations, is a cooperative effort of operators, operating supervisors, plant engineering, maintenance supervision and non-company services. Of first importance is communications, from top to bottom and in each of the following steps:

a. Sensing maintenance requirements
b. Scheduling and accomplishing the work
c. Completion, recording results
d. Evaluation and reporting; inquisitions and instructions

It is essential that the mechanical department be informed of any mechanical deficiencies whether true or suspect. Chemstone's Virginia operation uses the usual group of forms. Emphasis is placed on operators noting mechanical items on their shift reports. There may be gripes or suggestions but prevention of one costly failure is worth screening many gripes. Foremen follow-up of the operator reporting function is an every hour, every day repetitive operation pursued in the same manner that we all follow-up safety conscientiousness.

Good Housekeeping Creates Employe Pride

The operator must receive action on his reporting to maintain morale. If we expect him to be "on-the-ball," we've got to be "on-the-ball" too. A bound master book, into which all operator comments on mechanical items are logged by an accounting clerk, is maintained at Strasburg. Supervisors may make entries at any time. Maintenance request forms are also used and may be prepared by anyone in supervisory capacity, plant engineering or safety.

Equipment service personnel have defined responsibilities, and they maintain a complete check list for both historical and scheduling purposes. Since they are qualified mechanics, they also serve as good detectives for noting any unusual mechanical conditions. They report to the maintenance foreman, and also note questionable mechanical items in writing. Certain mechanics have plant areas or equipment designated for routine inspection and defined services, including lubrication and maintenance for which they are responsible. Equipment such as trucks, shovels, compressors and drills are removed from operation on schedules and cleaned, inspected, repaired and lubricated.

Houskeeping is an absolute starting point of preventive maintenance and must be carried on everywhere. Good housekeeping creates an infectious pride at all levels of employe participation, and as a result, we can go on to the optimums we all seek. Steam cleaning is used extensively; it's hard on the paint but worth it. It allows a more thorough inspection and creates a desire on the part of maintenance people to do craftsman-like work. It calls for the next step—repaint. Painting adds to pride of a job well done, helps operator morale, and is another step in extending equipment life. Some units are also checked for maintenance needs on a schedule by outside services who submit written inspection reports.

Through efforts of everyone looking for trouble and people checking on people, followed by further checks by other people with good communication procedures, one big step forward has been taken on preventive maintenance.

Recently an operator and a serviceman independently noted a coolant leak in the crankcase of a large new diesel engine. Repairs were relatively minor, but could have been extremely costly had it passed unnoticed.

Statistics Point-Up Potential Trouble Makers

Brief operating meetings are held at the Strasburg operation each morning with engineering, production, maintenance, accounting, and personnel; reviewing maintenance requests, preventive maintenance steps, operating schedules and costs. Causes of lost time and failures are discussed and operating and safety procedures are reviewed. They are put into written form wherever possible as instruction and procedures for operating personnel.

The company recently offered a truck driver who violated safety rules the choice of a week off or memorizing some 20 items of checking and operating procedures related to driving a quarry truck. He easily listed them after a week's study—so could some of his buddies since they worked on it together during lunch. This was a school-boy approach—in this instance extremely effective.

"The last thing I remember saying was: 'Mine safety is for the birds!'"

Quarry and plant operating statistics are summarized monthly at the Virginia operation where costs, availability, performance, and productivity are available at a glance and easily compared with past data. Such information reviewed by staff and line management clearly points up areas for greater concentration and at the same time may offer clues on potential trouble makers of tomorrow. But it's a waste of time and effort if not studied. The accounting department views this as another service to manufacturing, but they also start pinpointing items which normally might receive little or no attention.

Unit Replacement of Components Pays Off

A practice at Presque Isle Corp.—which pays off, but often takes a bit of selling to top management since it involves greater capitalization—is a system of repair that allows, wherever possible and plausible, for unit replacement of equipment components. This permits expert factory rehabilitation or for a better class of repair if done at the plant since rebuilding may be done under controlled shop conditions in contrast to working under the pressure of an emergency repair. This same practice is in effect at the Virginia and Georgia operations.

On the all-important word communications, Presque Isle uses a two-way radio system which has proven extremely valuable. Their team is in constant contact and is informed at all times of the status of operations.

To summarize, some personnel in top management should direct as much or more efforts to reduction of maintenance costs as they do to production costs. Records in some form, depending on the operation, are a very important part of a preventive maintenance program. Inspection, checking and receiving mechanical report data from all possible sources through an organized, continually functioning system is vital. This is covered by communications and reporting.

Operator training cannot be overstressed. Schooling by equipment suppliers is often well worthwhile. Scheduled equipment inspection by outside service groups can be rewarding.

If all management levels will apply at least as much effort to the reduction of maintenance costs as they do to production costs, the odds are good that maintenance costs will go down.

Improvements in Conveyor Belting in the United Kingdom—Part II

By S. WEINBERG
Chief Engineer (Specialist Services)
National Coal Board
United Kingdom

Part I of this two-part article described the problem faced by the NCB in raising the safety and serviceability standards for over 5500 miles of conveyor belting. The author now shows how the development of polyvinyl chloride (PVC) belting has improved safety in the coal mines of the United Kingdom and cut mining costs

Standards and Specifications Developed

Although the Approval system is still in operation, as it is in the case of many commodities, this situation may only remain until a fully comprehensive specification for belting for all necessary categories has been completed. Except for the delay in granting approval, however, this has proved to be no hindrance in producing belting to partial specifications which cover different requirements and at this time further parts of the specification are being developed for properties and tests recently investigated and relating chiefly to newer belts including man-made and synthetic fiber carcasses.

Requirements for purchasing demand that only belts with Approval, Provisional or Limited Approval can be bought for use underground or in surface applications where fire resistant belting is required.

The establishment of tests to define fire resistant properties was a pre-requisite for the introduction of belts with the necessary fire resistant properties, and these tests, as already described, were of necessity developed in the research laboratory. At first it was inadvisable to specify further standard requirements as the relationship between other possible laboratory test requirements and performance in service was not fully known. It was therefore left for each manufacturer to put forward the belts he considered the most suitable for the various duties. Each manufacturer was required to deposit his declared specification with the NCB in confidence.

The suitablity of the design of each belt was controlled by the Approval system, already described, and the quality of subsequent deliveries was checked by tests made against the manufacturer's declared specification and against the published standard specification for fire resistant properties.

The change-over to fire resistant belting proceeded rapidly through the next few years, and a fund of information was built from which performance in service, as evidenced by operational research, and other experience could be correlated with the different constructions of belt and with their performance on various laboratory tests. The outcome was the issue in 1960 of a standard specification having the following headings:

Part 1—Construction and physical properties.
Part 2—Method of test for tensile strength and elongation.
Part 3—Method of test for adhesion.
Part 4—Method of test for electrical resistance.
Part 5—Method of test for tear strength.
Part 6—Method of measurement of cover thickness.
Part 7—Method of test for fire resistance.
Part 8—Tension testing machine.

This specification set standards of performance which could be met only by certain belts, and the manufacturers of other belts have been given a year in which to bring their quality up to the specified levels. Figs. 7 and 8 are extracted from the above specification and refer to Part 1.

Work is continuing on the development of suitable standard laboratory tests which will define the various properties of a belt which are significant with regard to performance in service but are not yet covered by the standard specifications. Resistance to impact is an example of such a property. Tests are going on at the present time in which some of the factors to be determined are impact energy, speed, type, and geometry of the impact instrument. The criteria may be loss of mechanical properties after a single blow or after a number of blows. Alternatively, they may be the number of blows to achieve a given reduction in properties. The first step will be to standardize the apparatus so that all manufacturers can install it; subsequently experience and correlation will provide working criteria for a specification.

As specifications approach comprehensiveness, the need for an approval system diminishes and the laboratory tests can be relied upon to a greater extent to perform the screening once done on actual underground conveyors. Whether the Approval system can be dropped altogether is, however, a matter that has yet to be resolved; the indications are that it will be possible to drop it with present constructions and present material and to rely on the eventual specifica-

tion to control the quality level. For new constructions and new material, however, some caution may be advisable lest any of the standard tests prove incapable of giving a correct assessment with other constructions and materials. Nevertheless, with the vast experience that has been accumulated, it is attractive to consider the possibility of assessing the quality purely on the results of the different tests by giving to each test result a value weighted according to its importance. For instance, impact tests would be more important than flexibility, though a belt with incorrect flexibility would not be accepted at all. Some work is proceeding at the moment in an attempt to evaluate a belt, purely as a result of laboratory tests, in terms of its probable life in service against all forms of use and abuse.

National and International Standards

Standard specifications made initially within the NCB to control the quality of items purchased may gradually be adopted as national standards, as in the case of the British Standard 3289: 1960, "Conveyor Belting for Underground Use in Coal Mines," and in turn may be considered in the forum of the International Stnadardization Organization where valuable exchanges of views and experience take place between countries whose overall requirements may be different in each case.

Reference has already been made to operational trials which are used to assess the performance of experimental belts under severe conditions of working. These trials are still an essential part of the Approval routine and provide a unique method of evaluating the relative performance of belts with sufficient accuracy to enable classification of belts in a reasonable order of merit. Allowing for obvious approximations and the practical limitations of any trial carried out during normal operation it is possible, nevertheless, to place belts in three broad classifications of performance, namely Classes 1, 2, and 3 in that order of merit.

A few years ago, when the all-cotton construction was still the mainstay of belting developments, most of the belts were placed in classes 2 or 3. With the introduction of synthetic fibers more recent developments have produced a new family of belts, all in the top class, and significantly better than the normal run of belting. These belts have become known as "Premium" belts and although they may cost a little more than the all-cotton belt this fact can be more than offset by increased belt life and such belts can clearly have considerable economical advantages.

There is, of course, a range of belt constructions available to the user today. They vary considerably in construction, performance and price, and it becomes most important, therefore, to see that all the available belts are used to the best advantage on the right kinds of installation. This is controlled by placing belts in categories of duty.

The categories are related to the types and operating conditions of the conveyors and are grouped as follows:

Group A: Normal duty Gate and Trunk conveyors;
Group B: Heavy duty Gate and Trunk conveyors;
Group C: Face conveyors (subdivided into C1 for medium duty and C2 for heavy duty);
Group D: Surface Drift conveyors (subject to cold temperatures);
Group E: Steep gradients;
Group F: Wet conditions.

For example, a high performance "Premium" belt, which depends upon a synthetic carcass for its mechanical properties, will obviously show to its best advantage on a heavy duty face conveyor and will also be resistant to wet conditions. Such a belt would therefore appear in Category C1, F.

Under each category are listed the belts which, by virtue of their properties and constructions, are the most suitable for that (those) particular duty (duties) and these lists are issued to officials in the field to help

Belt Construction No.	Plies	Tensile strength (lb/inch width) 3	4	5	6	Elongation (per cent) At break	At proof load
1A	Warp	—	1480	1800	2100	15	
	Weft	—	680	830	970	8	
1B	Warp	—	1800	2200	2560	15	
	Weft	—	830	1010	1180	8	
1C	Warp	—	2160	2640	3080	15	
	Weft	—	1040	1270	1480	8	
2A	Warp	—	2200	2680	—	17	
	Weft	—	1200	1460	—	18	
2B	Warp	—	2500	3040	—	17	
	Weft	—	1350	1650	—	18	
2C	Warp	2200	2860	3480	—	17	
	Weft	1200	1560	1900	—	18	
3A	Warp	—	3200	3900	—		
	Weft	—	1200	1460	—		
3B	Warp	3500	4550	5550	—		
	Weft	1200	1560	1900	—		
3C	Warp	5000	6500	7900	—		
	Weft	1600	2080	2520	—		
4A	Warp		2200			18	
	Weft		1200			19	
4B	Warp		3000			18	
	Weft		1500			19	
4C	Warp		3800			18	
	Weft		1500			19	

NOTES.
(1) Each type of multi-ply belt is available in a preferred range of ply constructions as indicated in the above table. Where belts are required for special purposes in a ply construction not shown the appropriate minimum values may be obtained by extrapolation.
(2) Elongation values not shown in the table will be added at a later date.

Belt construction No.	Tear strength Number of plies 3	4	5	6
	lb	lb	lb	lb
1A	—	55	70	85
1B	—	65	80	95
1C	—	80	100	120
2A	—	200	250	—
2B	—	230	290	—
2C	200	260	330	—
3A				
3B				
3C				
4A		250		
4B		300		
4C		300		

Figs. 7 & 8. Tables indicate standard specification for tensile strength, tear strength and elongation of finished belting

them to select the most suitable type of belt for any given installation, thus assuring optimum usage of conveyor belting.

Part 1: 1960 of the current NCB Specification No. 158 deals with the constructions of finished belting, pertinent sections of which are listed elsewhere on this page.

Types of belt construction specified by the National Coal Board

(a) Construction No. 1

General purpose multi-ply belting for gate and trunk installations.

Belting shall be available in the following range of duties:—

Construction 1A—Normal duty.
Construction 1B—Intermediate duty.
Construction 1C—Heavy duty.

(b) Construction No. 2

High performance multi-ply belting for face conveyors and installations where working conditions are arduous.

Belting shall be available in the following range of duties:—

Construction 2A—Normal duty in 4-ply minimum construction.
Construction 2B—Heavy duty in 4-ply minimum construction.
Construction 2C—Normal duty in 3-ply minimum construction.

(c) Construction No. 3

High tensile multi-ply belting for extra heavy duty trunk conveyors.

Belting shall be available in the following range of duties:—

Construction 3A—4/5 ply for duties up to approximately 200 hp.
Construction 3B—3/5 ply for duties up to approximately 300 hp.
Construction 3C—3/5 ply for duties up to approximately 400 hp.

(d) Construction No. 4

High performance solid woven belting for face conveyors and installations where working conditions are arduous, and for extra heavy duty trunk conveyors.

Belting shall be available in the following range of duties:

Construction 4A—Normal duty.
Construction 4B—Heavy duty.
Construction 4C—High tensile duties up to approximately 200 hp.

This enables manufacturers to design belts for specific types of duty or, as in many cases, design variations of a construction so as to cover a wide range of duties.

Table 1 of the specification (Fig. 7) indicates the requirements in terms of tensile strength of the full belt thickness and elongation at break—a most important property. Some of the information is not yet complete and will be added later. While no material is specified, the defined properties give a fairly clear hint as to what textiles, for instance, ought to be used. Cotton belting is virtually at the end of its development. Further gains can only be marginal and achieved at great expense and effort. Its strength is limited and it is susceptible to changes due to atmospheric conditions. In addition, it requires inhibition in some cases against attack by bacteria and fungi. Very large quantities of 5-ply cotton belting were purchased in the past and it has provided a basis from which to measure both belt life and economy. Subsequent to the lifetime of presently installed cotton belting, it is expected that the whole system will quickly turn over to belting incorporating carcass constructions, largely of synthetic fibres, which though costing more per unit quantity in first cost, are beginning to achieve great economies by virtue of greater life, fewer breakdowns, etc. The rate at which the newer, including "Premium" belting will be purchased may depend on the amount of stock at a given time, since clearly improved belting at higher price can only demonstrate economy from the instant of installation. Holding in stock merely involves higher capital charges, and this is a significant consideration in large-scale purchasing.

Solid-woven belting, virtually a single complex ply, is intrinsically an expensive construction. In the early operational approval tests, it appeared not to be worth its cost, but it became obvious after examination that not enough credit was allotted to belting left intact at the end of the six months test, and a new method of analysis was applied allowing for extrapolated life. On this basis, and also because of somewhat better fastener-holding properties, the value of this belt assumed greater proportions and, for a long time, the best of these belts were the very best belts in use. Some of the recent experimental "Premium" ply type belts, however, seemed, on test, to be approaching the qualities of the best solid woven belts and, since they could be made somewhat cheaper, this development looked promising. At the present time there are at least two belts of ply construction which, on operational test at least, have given superior performances to those of the best solid woven belts and, since they are cheaper, quantities will be purchased for use in the field and to gain further experience.

Inspectors Visit Manufacturers' Plants to Control Quality

From the beginning it was obvious that the supply of such a large bulk commodity as belting would have to be done by production units controlled closely for quality of product. The NCB commenced a pilot scheme for inspection.

First visits to the manufacturers' works by the inspectors indicated that some manufacturers were not sufficiently instrumented for inspection and testing of conveyor belting, and some did not have the requisite stringent internal organization responsible for quality control. A minority were unaware of the requirements of the specification to which they were expected to produce belting. On the other hand, there were those whose control facilities were of the highest and, when augmented by the necessary apparatus for specification tests, gave every reason to expect uniformity of quality.

All belting manufacturers collaborated immediately with the inspectors and in a reasonably short time organized themselves with internal inspection staffs and the necessary instrumentation and record-keeping. Today it is rare that any of the regular suppliers fail through lack of proper arrangements at their works for control of quality.

The impact of inspection produced, in a relatively short period, a remarkable increase in the quality of the belting coming off the production lines with considerable economic advantages. At the end of the first whole year of operation of inspection it was calculated that the increase in the quality of nearly the same product had procured a saving of at least £500,000 ($1,400,000) in a total annual expenditure normally in the region of £15,000,000 ($42,000,000). Fig. 9 gives a rough idea of the impact of controls and inspection and demonstrates the rapid improvement in quality and reduction in quantities not complying with specification requirements from the inception. This trend has continued and has produced even greater savings as a result of development. In the functioning of their internal arrangements for inspection and quality control, the con-

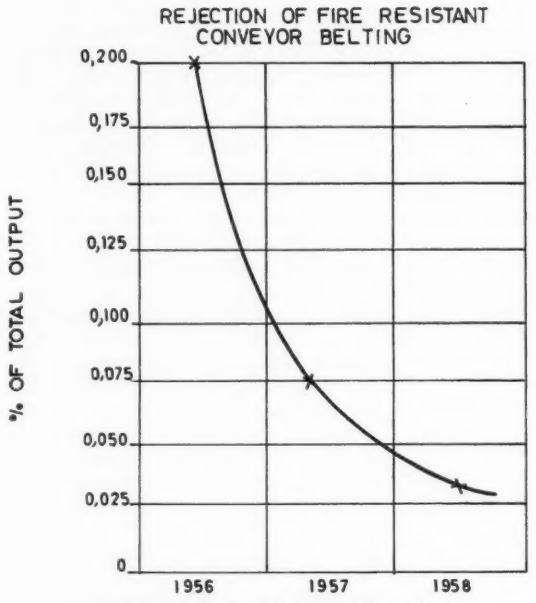

Fig. 9. Quality improved by inspection standards

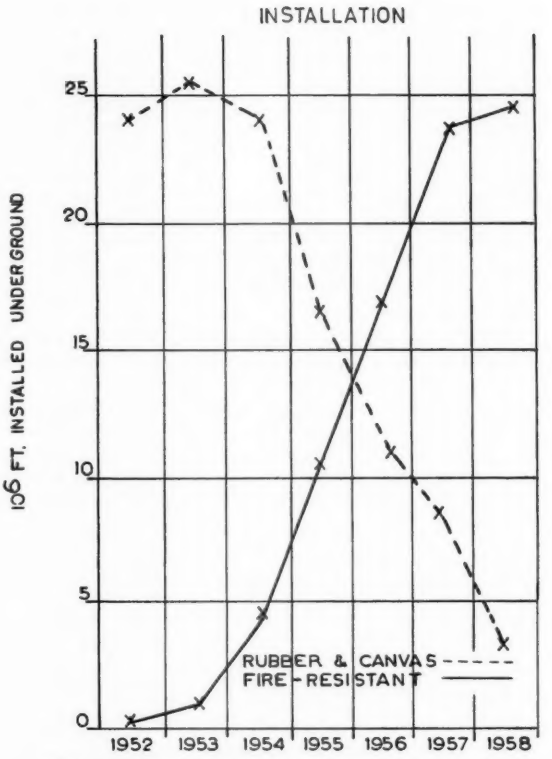

Fig. 10. Fire-resistant belting is rapidly replacing rubber belting

tinual testing and use of equipment provided information beyond mere compliance with specification and led to much development work in directions and on properties not yet specified. This was directed along lines which eventually produced the premium type of belting.

The position in this industry had become so satisfactory that it was found possible to establish a system of Delegated or Approved Firms inspection (called NICE—National Inspection of Colliery Equipment) at the beginning of 1961. Under this system the manufacturer is formally approved for the production of belting and, subject to agreed security controls, inspects his own product on behalf of the NCB whose inspectors are therefore able to reduce the frequency of their inspection visits to approved firms to a minimum.

Unsafe Belting to be Eliminated from Mines by End of 1962

By the end of 1962 it will be mandatory that no belting which is not fire resistant and safe shall remain underground in the United Kingdom. This excludes certain special belts for which exemptions are now in force until such a time as these also can be replaced by fire resistant versions and comprise chiefly cable belts. The general picture of the rate of installation of safe belting and reduction in rubber belting is shown in Fig. 10 which is not quite up-to-date. There is no doubt about the possible incidents that have been prevented by the use of fire resistant belting. Fig. 11 shows a piece of belt involved in an incident. The belt was of standard 6-ply cotton-PVC construction 30 in. wide. The belt jammed at the inby end and the effect of the driving drum against the stationary belt at the outby end is shown. Examination of the piece of belt showed that much of the cover was black and brittle and, as can be seen, the PVC between plies had melted, allowing the plies to separate, but without any sign of ignition of the cotton duck. In the pit concerned the outby end of the conveyor is very close to the shaft bottom and had a fire developed there the whole pit could have been in danger with the possibility of the loss of human life. This incident is mentioned as an example which justifies the great effort and cost which has been put into the development of fire resistant belting and into the changeover to the general use of this type.

The developments described have been so successful that many industries, in which fire resistance is not a criterion, are beginning to adopt PVC belting as used underground, not only for its mechanical properties, which of course are not a

Fig. 11. Fire-resistant belting although severely rubbed by driving drum, did not burn.

function of the cover but have been developed in this period, but also for the improved resistance to abrasion given by the cover. The carcass development has also applied to types of belting other than those used by the NCB.

The mechanical properties of synthetic fibre belts lie in a much higher range than those of cotton and, as a result, considerations of conventional types of construction for extremely heavy duties are going on. This will eliminate many of the transfer points formerly used and will have significant effect on costs of conveying besides, possibly, reduced breakage and degradation of the coal carried.

Better Fastenings Being Developed

The problem of fastenings is a serious one and is engaging our attention at the present time. Metallic hook type fasteners are attractive in that a joint can be made relatively speedily and allowance is possible with this type of fastening for modification to a belt length after certain initial stretch has been worked out. Research has shown that static or tensile tests on these fastenings are of relatively little value, since failure may be accelerated by fatigue in traversing pulleys. For that reason, a dynamic test has been set up at our Mining Research Establishment which enables examination of existing and new types of fastener in order to indicate their value. The test is also being used to evaluate the relation between the fastener and the weave or construction of the fabric—a most important consideration.

For more permanent installations, a process parallel to the vulcanization of rubber is of course used. This fastening takes longer and, in the event of a breakdown, may have to be replaced by a temporary fastening in order to continue production, but it is strongly recommended and, with the improvement in belt strength and quality, is advantageous. One of the disadvantages of the solid woven belt is its inability to be fastened by such a process, and this may be a setback for very heavy duty in the case of a belt which for normal and heavy duties is of the highest quality. Needless to say, there is much thought being given to this problem.

"Driveability"

In the early developments, as mentioned above, the finished surfaces were relatively hard and glossy thus giving rise to the popular belief that PVC had a lower coefficient of friction than rubber. After the demonstration of the effect of increased proportion of plasticizer, however, it was found by experience that normal methods and procedures used for rubber belting were moderately applicable to PVC. Nobody has yet produced a satisfactory measurement of coefficient of friction of this type of material because the nature of the surface changes with each usage, but work is proceeding on the study of "driveability" which is one way of incorporating the effect of friction.

Because of the requirements of fire resistance, it is better to increase angle of wrap, e.g., by the use of two or more driving drums, than use a material with higher coefficient of friction, since this means, however intrinsically fire resistant, that the heat generated in stalling conditions might be so great as to ignite coal dust or surrounding material. For this reason the practice of 'lagging' single driving drums is not considered good engineering and is only tolerated as an interim measure when the lagging is of fire resistant material.

In an earlier section it was indicated that the target for maximum available life by development was influenced partly by factors incapable of control, such as roof falls and ground shifts, and partly by improvements in environmental engineering, installation, maintenance and repair. Advice to improve these latter factors would therefore have a significant effect on the economics of conveying. An Information Bulletin "Relating a Roadway Belt Conveyor to its Duty" was issued throughout the industry primarily to enable installations to be made correctly in regard to the design of belt. This included several useful nomographic charts which simplified the selection of a belt for a particular duty. Additionally, a Code of Practice in which other aspects of installation, maintenance, signalling, safety, auxiliary equipment, and many other features, is under consideration. Finally, it is our policy at Headquarters of the NCB to keep the users in the field constantly armed with advice regarding latest proved developments. This is performed through the media of Memoranda of Recommendations.

Future Demands Continuous Improvement of Belting

The future for belt conveyors seems to point generally to full use being made of the greater and still greater strengths which are becoming available. Demands of the electricity generating industry, for example, which is now talking of coal burning stations of capacities of 2000 MW (2,000,000 kw) or more and which may well take the total output of several collieries, obviously imply the transport of coal both underground and on the surface on a very large scale. This will require very large conveyors whose design and reliability will have to be of the highest. Costs of production in an extractive industry must be constantly under review and since such a large proportion of its output is transported on belt conveyors, the economics of these, as influenced by new developments, will always be of importance.

"Am I spelling too fast for you?"

Importance of Research in Creating Mineral Resources*

By Thomas B. Nolan
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LONG range research seems to be one of our great needs if we are going to maintain the mineral resource base that is essential for the well-being of our national economy.

Mining people in general are familiar with the concern that is being expressed in many quarters as to the adequacy of our natural resources of all kinds, in relation to what are considered to be future needs. Insofar as mineral resources are involved, this concern reflects a growing, and badly needed, national awareness of the necessity to develop now the plans and programs that will assure us of meeting these needs and is fully justified; but to the extent that this concern reflects a pessimistic view of our resource potential, the author does not share it. On the contrary, we can not only maintain our mineral resource base, but also expand it into the far distant future, provided we approach the task with intelligence and vigor.

Before discussing the basis for this optimism, or describing some of the programs that the writer thinks ought to be undertaken to make certain of future supplies, it might be well to consider the definition of mineral resources and what seems to be a popular misconception concerning them. It is fair to define mineral resources as naturally occurring materials—minerals and rocks—that can yield a product which may be used by man. No one would quarrel with this definition, but in practice many people concerned with the resource problem overlook the qualification that a resource is a usable substance. This oversight, in turn, leads to the misconception that resources are fixed in quantity, and hence are exhaustible according to a predetermined schedule.

Resources Created by Research

It is true, of course, that the amount of a given material in the earth's crust is fixed. But which, and how much, of these materials are usable at any time and thus constitute a mineral resource, depends upon what man's knowledge makes it possible for him to use to his advantage at that particular time. For example, the material of critical value to Stone Age man was flint, and if he had surveyed the mineral resources of his world, he would not even have thought of listing most of the several hundred rocks and minerals used in the United States today. Before he learned to control fire, he could not live in large parts of the world, and his resources of arable soils were but a fraction of the acreage so classed today.

Resources, then, are literally created by man through research that develops new uses for raw materials, research that permits the recovery of ores of lower quality than were previously minable, and research that makes it possible to discover concealed deposits of usable raw materials.

Discovery of Fission Led to New Energy Source

Rather than exhausting his natural resources by profligate use, as is so often claimed, throughout history man has created resources as his knowledge has advanced, and he is still doing so today. For example, only a few years ago, our resources of energy were thought to be known quantities, exhaustible in a few hundred or at most a few thousand years. The discovery of fission, however, created an entirely new source of energy from uranium, and the development of fusion likely will create another one from deuterium and other light elements.

Admittedly, difficult problems in the field of nuclear energy remain to be solved, but nuclear power plants are already a reality, and the writer is told that we may expect the breeder reaction, making possible the use of thorium and uranium 238 as well as uranium 235, to be perfected in the near future.

Assuming they will be used in the

A vast potential source of low-grade uranium ore is the Chattanooga shale, whose development awaits the results of technologic research

* *Adapted from a paper presented at the American Mining Congress Convention, Seattle, Wash., September 11.*

Beryllium-detecting instrument is another tool, like the airborne magnetometer and scintillation counter, for finding high-grade mineral deposits that may be concealed beneath covering rocks

breeder reaction, the known reserves of uranium and thorium in domestic ores minable at current prices contain somewhere between two and ten times as much energy as our entire coal reserve. Moreover, as little as 100 parts per million of uranium is now being recovered economically from phosphate rock as a by-product of the manufacture of triple super phosphate, so we are safe in assuming the progressively lower grade uranium ores will soon come within reach.

As this happens, our energy resources will increase many times further, for several common rocks—phosphate rock, black shale, and alkalic granites, for example—contain 50 ppm or more of combined uranium and thorium. Even now, it is hard to get used to the idea that a ton of rock, such as the Chattanooga black shale in Tennessee or the Conway granite in New Hampshire, contains energy equivalent to that of 150 tons of coal, but what is more to the point is that the possibility did not even exist a couple of decades ago. Here, then, a tremendous potential resource has been created by research before our eyes; other examples that are almost as impressive could be cited.

Emphasizing that resources are created by research does not imply that we need give no thought to conserving our known reserves, though we should interpret conservation to mean wise use rather than hoarding. There is no intention, either, to give the impression that our resource problems will somehow be solved through the magic of science without any effort or concern on our part. On the contrary, a necessary corollary to the idea that resources are created by research is a need to provide the environment and secure the support that will make possible the research required; these are fundamental prerequisites for any attack on the problem of increasing our mineral resource potential.

What Kind of Research is Needed?

Now, what kind of research must be done to develop supplies of raw materials for the future? It seems that three general categories are desirable: 1) research that will develop either new uses for raw materials currently in use, or that will call for the utilization of materials that are presently little used for any purpose; 2) research that will make it possible to extract valuable materials from deposits that can not be mined or processed economically now; and 3) research that will allow us to predict the location and nature of deposits that do not outcrop, or are concealed by superficial deposits.

Of these three categories of research, it is likely that the first—the development of new uses for raw materials—has done the most to open new possibilities of economic growth and to raise man's level of living throughout the ages. Nearly all the terms used to signify the different periods of man's development—the Stone Age, the Bronze Age, the Coal Age, the Iron Age, the Nuclear Age, and so on—reflect the utilization of raw materials that were previously valueless but whose newly discovered use materially changed man's standard of living. Similar discoveries will no doubt continue to take place at an ever accelerating rate.

We are witnessing now, for example, explosive growth in the use of a dozen or so elements that were hardly known outside of the chemical laboratory just a few years ago—beryllium, niobium, selenium, tellurium, and germanium are a few of the currently "hot" elements for which highly specialized uses are developing. Other examples, some of which are well known, would include the development of magnesium, zirconium, and titanium metals and alloys as structural materials. These and countless similar developments are ample evidence in themselves of the high level at which research is in progress in this general field. The writer has the feeling, however, that the bulk of the physical, chemical, and engineering research that is yielding these new developments is stimulated by military and space ex-

ploration programs of one kind or another, and that even more rapid progress might be obtained if both basic and applied research were to receive greater encouragement from non-military sources.

Advancing Technology Led to Use of Taconites

The second category of research —research that will make it possible to extract minerals from deposits that can not be mined or processed economically now—is more the responsibility of those directly concerned with mining than is research directed at the development of new uses of raw materials. Progress in this field has not been as spectacular as that just described, but it has been impressive nevertheless. It is this type of research, for example, that has made it possible for us to use our taconites, and thus create a tremendous resource of iron ore, a quantity so large that our total reserves of minable iron ores stand higher now than ever before.

One could say categorically, in fact, that were it not for advances in mining and metallurgical technology, supplies of nearly every metal mined 100 years ago would now be badly depleted, for the metal content of the tonnage of the high-grade ores mined then was small in terms of present demand.

But whereas much progress has already been made, much more is needed. The simple truth is that the tonnage of any element in high-grade ores is small compared to that in low-grade ores, and there is no doubt that we will depend more and more on low-grade sources as time goes on. Although it is currently fashionable to view this prospect in terms of the dire consequences we can anticipate when our high-grade deposits are exhausted, it seems that it is much more realistic to recognize that development of the technology necessary to utilize progressively lower grade ores will make bountiful supplies of raw materials available to all mankind.

In the same category is the problem of finding ways to mine coal, oil, and similar minerals without leaving half or more of each deposit in the ground. Perhaps the present practice of reporting reserves of these minerals in terms of the tonnages that known technology permits us to extract from the ground is the proper one but, on the other hand, it makes us lose sight of half of the apple that ought to be drawing us into more research on improved methods of extraction.

Recovery of Coproducts from Low Grade Deposits

While it is important to emphasize the large tonnages of most elements and minerals that are available in low-grade deposits, another attractive feature of these deposits lies in the fact that many of them contain two or more valuable elements or minerals; though each of the valuable elements may be present in only small amounts, collectively they add up to a substantial value. Rather than saying they offer possibilities for recovery of by-products, the writer prefers to emphasize the goal of both economy and conservation by saying that the processing of many low-grade ores should be viewed as a coproduct operation in which all of the usable materials are recovered.

An example of such a coproduct operation is the treatment of the Cambrian "alum shale" in Sweden. As described to the author several years ago, five and two percent by weight of this black shale were recovered as oil and sulfur respectively; an additional five percent in oil equivalent was recovered as gas and heat, the latter being converted to steam and sold as electric power; the remainder was then processed to make building materials and somewhere in the process about 0.4 percent of vanadium was recovered from it. Though not mentioned at the time, uranium probably was also recovered; if the "alum shale" has a composition similar to some other black shales, it may also contain significant amounts of selenium, zinc, nickel, and molybdenum. Although this operation is most ingenious, other examples could be cited to document the promise that this approach holds as a means of exploiting lower grade ores economically and thereby creating additional resources.

Level of Spending for Mining Research is Low

Certainly research on mining and metallurgical technology ought to receive far more support from both industry and government than is the case now. Whereas an average of about four percent of the sales value of the products of other industries is spent on research, the comparable figure for the mining industry is much less, being on the order of less than one percent.

Those plagued by surplus production of one or another mineral may not feel as strongly about the need for accelerated research in this field as the writer, who contends that its results would yield quick benefits to domestic producers who are suffering from competition with foreign sources. True, the new techniques would eventually be applied abroad as well as at home, but the level of our technology and the level of training of our labor force permit us to take advantage of such advances more quickly than most others are able to do.

The status of the third category of research, research in the science of ore-finding, is somewhat similar to research in mining and processing technology: the progress is measurable but insufficient to solve many of the problems that are facing us. Of these problems, three are most pressing in terms of future demands: the first and most difficult is, how can we discover the ore deposits that surely exist beneath the earth's surface but are wholly concealed? The second is, what are the origin, habits, and probable extent of the deposits of the "new" elements—tellurium, selenium and others that have had little value heretofore and hence have received so little notice that we hardly know how to go about prospecting for them? And the third is a related but perhaps easier question, what are the habits, the nature, and the characteristic environments of the low-grade deposits, knowledge of which will help us to explore for ores that may be profitable to mine?

Ability to Find Concealed Deposits Limited

Excellent strides, of course, have been made in developing methods and principles applicable to the search for concealed deposits of oil and gas, and the development of instruments such as the airborne magnetometer and airborne radiation detector has made it possible to search more effectively for wholly concealed deposits of a few other minerals. Moreover, study of the genesis and habits of ores in specific districts has led to much success in searching for blind ore bodies in adjacent areas (the recent discovery of ore bodies beneath a concealed thrust fault in the East Tintic district is a bright example of scientifically guided ore-finding within a known district). But for many minerals we do not yet have the knowledge that permits us to search effectively for concealed deposits beyond the limits of known areas of mineralization or beneath extensive cover.

Someone has quoted the president of a small oil company as saying that he didn't care what methods were

used to find oil as long as they worked; he would, he said, even use a cat with a tin can tied to its tail if it had a good record. Every exploration man has probably hoped for some such simple and economical device, although what the effect of such a gadget on current overproduction would be is sobering to consider. It is doubtful that we will find any solution—simple or complex—that does not depend on a clear understanding of the origin and habits of ore minerals, combined with accurate knowledge of areal geology—it is this combination that has led to the success already achieved in the discovery of concealed deposits. Continued research on both fronts will give us the knowledge we need to discover the concealed ore bodies that are presently beyond our capacity to find.

Suggested that Many Districts Await Discovery

Inasmuch as there is no simple or inexpensive way to search for concealed ore deposits, the question might be raised as to whether it would not be simpler to concentrate on research of the low-grade ores, on which we will have to depend ultimately, and not spend any more time and money on the difficult problem of searching for concealed deposits. Actually, similar work is needed to guide the development of low-grade sources, and it is doubtful that we can avoid doing it; but if the problems were completely different, the question would turn on the number and value of the concealed deposits that remain to be found.

In regard to the first, a common assumption, which geologically seems to be valid, has been that on the basis of the ratio between exposed and concealed areas, that there are at least two or three times as many deposits yet to be found as have been discovered thus far. This is probably a conservative estimate, for each year new discoveries on the outcrop remind us that all of the ore deposits that lie beneath exposed areas have not yet been discovered.

So far as the value, as well as the number, of undiscovered concealed ore deposits are concerned, a review which the writer made some years ago showed what seemed to be a statistically sound relationship between the number and size of productive mining districts and the surface extent of geologically similar large areas. This approach also leads to the conclusion that many districts remain to be discovered, perhaps as many as ten times those now known; in addition it suggests that among these undiscovered districts, there will be the same relative number of major districts, or "elephants" as has been found up to now.

Value of Concealed Deposits Believed Colossal

The petroleum geologists have attacked the problem of ultimate reserves in a somewhat similar manner, by attempting to derive the ratio between known and total petroleum accumulations. Because the petroleum content of a given cubic mile of sedimentary rocks appears to vary within what are, geologically speaking, relatively narrow limits, petroleum geologists have been able to estimate the ultimate petroleum resources, that is, the total that occurs in both known and unknown fields. Very likely these estimates of ultimate resources are also conservative —at least they continue to be revised upward—but at any rate cumulative production and proved reserves are about a sixth of the total believed to be present in the ground, and cumulative production alone is about one-ninth of this.

Most mining people would acknowledge that exploration for petroleum is a good deal more advanced than that for most other minerals, and that we have probably found and mined a good deal less of the mineral deposits that actually exist within the United States of a quality comparable to those being mined now. Hence, it seems reasonable to assume that the value of undiscovered mineral deposits other than the fossil fuels is at least ten times that of the production to date, giving us a target of roughly a trillion dollars in concealed deposits. This is the value of the resource that might be created by improving methods of ore finding, and few would question that it is a target worth shooting at.

Search for Uranium Shows What can be Done

As mentioned previously, the major advances in economic growth throughout man's history have come as the result of discoveries of new uses for raw materials. It is therefore important that we attempt to satisfy the demands for "new" elements, such as tellurium and selenium, for which new uses are just being discovered. Because so little is known about the occurrence of these elements as yet, it is difficult to plan a sound exploration program for them, but the results that may be expected from research-based exploration are vividly illustrated by those obtained in the search for uranium —itself a "new" element less than 20 years ago. In 1940, there did not even exist an estimate of U. S. or world reserves; little was known even of the deposits then being mined, and there was grave doubt in the minds of many concerned with the problem

"To what do you credit your uncanny success at locating rich uranium deposits?"

that enough high-grade ore existed to support military needs, much less projected civilian uses for the future.

The program carried out, both in this country and abroad after 1940, however, rapidly changed this picture, and it appears now that uranium ores are relatively as extensive, if compared on the basis of the abundance of the elements in the earth's crust, as are the ores of metals sought for a long time. Another interesting fact is that in 1940, nearly all of the known reserves consisted of vein deposits, and for several years other types were considered unimportant; now, however, about 90 percent of the minable reserves in the world are in sedimentary rocks, such as the sandstone deposits of the Colorado Plateau and the conglomerate deposits in Ontario and South Africa.

A similar situation is unfolding now with respect to beryllium. Outside of a few minor deposits, the principal source of this metal was thought until recently to be in pegmatites in the form of beryl. The discoveries of phenacite and bertrandite in Nevada and Utah have opened up entirely new horizons in the search for beryllium, and as these minerals are almost indistinguishable, to the naked eye, from ordinary quartz, it is easy to imagine that important deposits of them are present in ground we thought had been intensively prospected. Because of experiences such as these, there is every reason to believe that research-based exploration for other "new" elements will disclose large supplies previously unknown, or even unimagined.

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Ingenuity Needed to Create Resources

For reasons already mentioned, study and appraisal of our low-grade sources of minerals need to be pressed much more thoroughly in the future than they have heretofore. Until recently, the Geological Survey was one of the few organizations in this country concerned with this subject and although we are still probably doing most of the work in this field, it is pleasing to note that some of the larger mining companies are also beginning to explore the black shales and other low-grade deposits. The Survey hopes to accelerate its work in this field—in fact we are starting this year a continuing study which we have called, for lack of a better term, a geochemical census, to acquire data on the distribution of the elements in ordinary rocks which is intended to vastly improve our knowledge not only of our low-grade deposits but also of the distribution and origin of the "new" elements. It is to be hoped that more companies in industry will also begin to investigate these potential resources, particularly those that offer possibility of a co-product operation.

The writer hopes that he has justified to some extent the basis for his optimism concerning our ability to meet future demands for minerals. Some people may question the precision of the statement that we create mineral resources by research, but this concept has been shown to be a valid one. In conclusion, though, its double significance needs restating for emphasis—it not only means that resources are created by ingenuity but it also means that it takes ingenuity to create them. We are living now not from the bounty of nature but from the fruits of human intelligence, and whether we will maintain or expand our affluence depends on our willingness to aggressively expand our inquiry into the phenomena and laws of nature.

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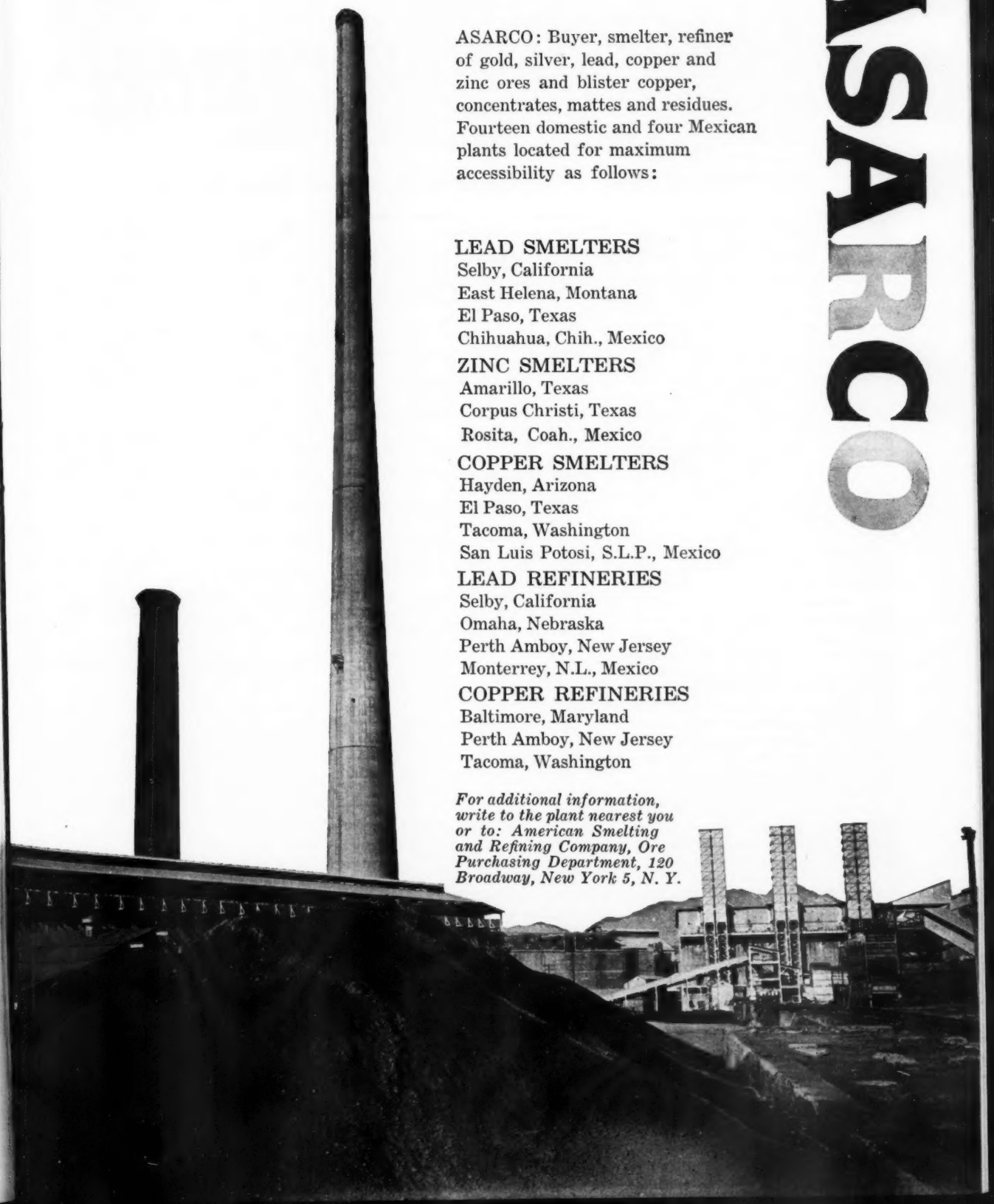

As Viewed by HENRY I. DWORSHAK of the American Mining Congress

ENDING the longest session in 10 years, the first session of the 87th Congress adjourned September 27. Congress will reconvene January 10.

While much of President Kennedy's legislative program was acted on, many of his proposals were put off until next year. His principal victories came early in the session. They were enactment of anti-recession bills to (1) provide Federal subsidies to aid depressed areas, (2) increase the minimum wage and broaden its coverage, (3) extend temporary unemployment compensation payments, (4) increase and expand Social Security benefits, and (5) provide Federal subsidies for housing, including urban renewal projects.

On the international front, Congress responded to increasing tensions by authorizing record peacetime defense expenditures and a five-year foreign aid program.

As a result of these increased expenditures, the Kennedy Administration expects a budget deficit this fiscal year of between $5 billion and $6 billion. Other sources expect it to run considerably higher, possibly $7 or $8 billion—partly because of a deficiency in receipts and partly because of higher spending than projected.

For the current fiscal year, Federal spending is officially expected to rise from $81.5 billion last year to $87.7 billion, or about 8 percent.

★ ★ ★ ★ ★ ★

WASHINGTON HIGHLIGHTS

CONGRESS: Adjourns until January 10

MINE SAFETY: New law provides for two-year study

FUELS POLICY: Committee to make broad study

WILDERNESS BILL: Western hearings scheduled

HANFORD PROJECT: Defeated by House

LEAD—ZINC: Congress okays subsidy measure

MINERAL IMPORTS: Tariff Commission plans study

IMPORT TAXES: Baker bill approved by Committee

COAL: Mines Bureau forecasts rising demand

TARIFFS: Reclassification bill moves

★ ★ ★ ★ ★ ★

NEW LAW AUTHORIZES METAL MINE SAFETY STUDY

President Kennedy has signed into law a bill authorizing the Secretary of the Interior to conduct a two-year study of safety and health conditions in metal and nonmetallic mines. The measure, which originated in the House, was passed by the Senate near the end of the session.

The study will cover costs of injuries and health hazards; the relative contribution to safety of inspection programs embodying (a) right-of-entry only and (b) the right of entry plus enforcement authority; the effectiveness of health and safety education and training, and the scope and adequacy of State mine safety and health laws and the extent of their enforcement.

The law provides that any duly authorized representative of the Secretary of the Interior shall be entitled to admission into mines and to require reports from the operator of any metal or nonmetallic mine.

At the conclusion of the study, the Secretary will report his findings to Congress together with recommendations "for an effective safety program for metal and nonmetallic mines."

SENATE COMMITTEE WILL MAKE NATIONAL FUELS POLICY STUDY

After long urging by coal industry spokesmen, the Senate has adopted a resolution authorizing the Interior and Insular Affairs Committee to make a thorough study of (1) current and prospective domestic fuel and energy resources and probable rates of consumption, and (2) governmental policies and laws affecting the fuels and energy industries, to determine whether any changes may be advisable in order to coordinate and provide an effective national fuels policy.

In addition to the members of the Committee, these Senators will participate in the study: Randolph (Dem., W. Va.), Engle (Dem., Calif.) and Cotton (Rep., N.H.).

Coal industry consultant to the Committee during the study will be Dr. C. J. Potter, president, Rochester & Pittsburgh Coal Co., Indiana, Pa. Dr. Potter was deputy solid fuels administrator in the Department of Interior in World War II.

HOUSE SUBCOMMITTEE SLATES WILDERNESS BILL HEARINGS

Chairman Gracie Pfost (Dem., Idaho) of the House Interior Subcommittee on Public Lands has scheduled three field hearings on the Wilderness bill passed by the Senate last month. These will be held at McCall, Idaho, October 30–31; Montrose, Colo., November 1, and Sacramento, Calif., November 6.

Representative Pfost said that her subcommittee would study all aspects of proposed wilderness legislation. She emphasized that field hearings are being held to enable the people of States that would materially be affected by the legislation to make their views known. It was indicated that further hearings will be held later.

The Wilderness System, under the Senate-passed bill, would include some 15 million acres of national forest lands now classified as wilderness, wild or primitive areas but

which are presently subject to the general mining laws. The bill would limit prospecting and mining on these lands to specific areas selected by the President and under regulations prescribed by him.

Spokesmen for the mining industry and other natural life resources industries will express their opposition during the hearings.

HANFORD ELECTRIC PROJECT DEFEATED BY HOUSE

The House finally won its fight to block Federal construction of an electric power plant using steam generated at the Hanford, Wash., plutonium reactor of the Atomic Energy Commission. The victory was hailed by coal and electric utility spokesmen, who had opposed the project on the basis that it would be tantamount to Government subsidy at high cost of a competing source of energy.

The proposed $95 million Hanford project had been included originally in the annual AEC authorization bill. After the house deleted the project and passed the measure, the Senate restored it as an amendment. On two occasions the House refused to accept this amendment, and later it rejected a scaled-down amendment under which the Hanford reactor facility would consume all of the power produced. The Senate then agreed to deletion of the amendment in order to clear the bill for the President.

Dropped from the bill at the same time was an amendment authorizing a $5 million nuclear research program in coal. Later, in the measure appropriating funds for AEC operations, Congress authorized the use of up to $1.5 million to initiate the nuclear coal research project.

CONGRESS APPROVES SUBSIDY BILL FOR SMALL LEAD–ZINC PRODUCERS

Following Senate Finance Committee rejection of the Anderson bill, which would have placed import taxes on lead and zinc at rates higher than present tariff duties, the Senate approved the Edmondson subsidy bill passed earlier by the House. The measure has been signed by the President.

It authorizes the Secretary of Interior to make subsidy payments to small producers of lead and zinc ores and concentrates over a 4-year period.

Payments to eligible producers, in the case of lead, would be equal to 75 percent of the difference between what they receive based on the market price and what they would have received at a market price of 14½ cents per pound; in the case of zinc, payments would be equal to 55 percent of the difference between market basis and 14½ cents.

Each producer would be paid on up to 1,500 tons of each metal (in ores or concentrates) in 1962, 1,200 tons in 1963, 900 tons in 1964, and 600 tons in 1965. Appropriations totaling $16.5 million are authorized to cover the program's cost. If the President approves the bill, he will undoubtedly ask for an appropriation early in the next session to inaugurate the program.

Payments could be made only to producers who did not mine more than 3,000 tons of lead and zinc combined during any one of the past 5 years, and no producer could be paid for tonnage in any year in excess of his maximum production during any of the years 1950–1960. No mine or operating unit would come under the program unless it had been in actual production at some time during the past 5 years.

Later, the U. S. Tariff Commission announced that conditions in the domestic lead-zinc mining industry warrant retention for another year of current import quotas on the two metals and their ores and concentrates.

TARIFF COMMISSION TO MAKE MINERALS STUDIES

In compliance with a Senate resolution adopted September 23, the Tariff Commission will bring up to date its comprehensive reports on the lead, zinc, mercury and fluorspar industries and submit the data to Congress not later than May 15, 1962.

The resolution also directs the Tariff Commission to make similar studies with respect to manganese, cobalt, and beryllium, and report to Congress before September 1, 1962.

The reports will contain data on domestic production, foreign production, comparative labor and other costs of domestic and foreign production, imports, consumption, channels and methods of distribution, U. S. exports, and other factors affecting the competition between domestic and imported products.

HOUSE COMMITTEE APPROVES LEAD–ZINC IMPORT TAXES

On the last day of the session, the House Ways and Means Committee favorably reported the Baker bill, which would impose flexible import taxes on lead and zinc metal, ores and concentrates, and manufactures. The measure must now be approved by the House Rules Committee before it can be voted on by the House.

The import taxes, part of which would be permanent and part on an "on-and-off" basis, would be at somewhat lower levels than those rejected earlier by the Senate Finance Committee. Permanent import taxes on lead would be as follows: Pigs, etc., 2 cents; ores and concentrates, 1.4 cents; and manufactures, 1 cent. If the average market price of lead, as determined quarterly by the Tariff Commission, is less than 13½ cents per pound, the following additional taxes would be applicable: Pigs, etc., 1 cent; ores and concentrates, 0.75 cents; and manufactures, 1 cent. The additional duties would cease to apply when the price is determined to be 14½ cents or more.

For zinc, the permanent import taxes would be as follows (with the additional on-and-off rates shown in parentheses): Slabs, etc., 1.5 cents (1 cent); ores, concentrates and fume, 1.05 cents (0.7 cents); and manufactures, 0.8 cents (1 cent). Price bases in the case of zinc are 12½ cents and 13½ cents.

Except in the case of manufactures, present tariff duties would be revoked; present import quotas on lead and zinc metal, ores, and concentrates would also be eliminated.

MINES BUREAU OFFICIAL SEES RISING COAL DEMAND

Demand for coal in the United States should reach 670 million tons a year by 1965, according to T. Reed Scollon, chief of the U. S. Bureau of Mines' Division of Bituminous Coal. In 1960, the Nation produced approximately 434 million tons of bituminous coal and anthracite.

He said this forecast is primarily a projection of present trends affecting fuel consumption, including coal technological developments, but with no assumptions of possible major changes in technology or other developments that might significantly alter coal's position in the years ahead.

Most of the coming increase in coal demand will result from expansion of electric power generation, Scollon said. Coal is expected to provide the largest share of energy required in achieving an annual output of 1,775 billion kilowatt hours of electricity—the Federal Power Commission's estimate for 1975. The amount of coal used for power generation alone in 1975 may thus exceed last year's total production, Scollon stated.

COMMITTEE APPROVES TARIFF RECLASSIFICATION

Just prior to adjournment, the House Ways and Means Committee

(Continued on page 102)

personals

Robert H. Hughes, president of Clinchfield Coal Corp. for the past nine years, has been named chairman

R. H. Hughes

C. K. Tieche

of the board. **C. Kyle Tieche** succeeds Hughes as president.

Hughes has been associated with the Clinchfield organization since 1935. He had held various engineering positions including assistant chief engineer and chief engineer when he became vice president of operations in 1951 and president in 1952.

Tieche, who has been in coal industry operation for 28 years, began his career in the engineering department of Virginia Iron, Coal & Coke Co. in 1933. Since 1935 he has been in production and mine management. He joined Clinchfield Coal in 1947 as production manager, and was named vice president of operations in 1952.

D. N. Hall, formerly comptroller, was named vice president—administration.

Ralph W. Neyman has retired as president of Federal Resources Corp. and has been succeeded by **Nels W.**

R. W. Neyman

N. W. Stalheim

Stalheim, who will serve as president and chief executive officer. Neyman joined Federal in 1956 as president and general manager after more than 25 years with Hecla Mining Co. He will continue as a director and consultant in connection with the Conjecture mine project in north Idaho. **Floyd B. Odlum,** retired chief executive officer of Atlas Corp., has been named chairman of the board, succeeding Stalheim, and senior officer of Federal.

J. S. Whittaker, vice president—operations of Pittsburgh Coal Co., has been elected president and a director of Mathies Coal Co. He also will continue with Pittsburgh Coal in his present capacity. Whittaker has been with Pittsburgh Coal since 1939. In 1951 he became director of safety and three years later general superintendent. Since 1957 he has been vice president—operations.

Robert C. Hills has been elected president of Freeport Sulphur Co. He succeeds **Charles A. Wright,** who became vice chairman of the board.

R. C. Hills

Hills has been a director and executive vice president of Freeport since 1955. He joined the company in 1934 as an assistant chemist at its Grande Ecaille sulphur mine in Louisiana. Named assistant to the president in 1947, he was elected a vice president in 1950. As executive vice president, Hills has been in charge of Freeport's present five sulphur-producing properties and was responsible for the construction and start-up in 1960 of the world's first off-shore sulphur mine at Grand Isle, La. He is also president of Freeport Nickle Co.

Frank B. Warren, president, Bessemer Limestone & Cement Co., has been appointed chairman of Bessemer Cement Co., the newly created division of Diamond Alkali Co. which resulted from the merger of the two companies. Warren also was elected to Diamond Alkali's board of directors, succeeding **J. H. McNash,** who resigned.

Herbert E. Jones, Jr., president of Amherst Coal Co., has been elected president of the Logan (W. Va.) Coal Operators Association. At the same time **William Crawford,** who is vice president of Princess Coals, Inc., has been elected vice president of the Association.

A. E. Petermann, vice president and general counsel of Calumet & Hecla, Inc., was recently named a member of the executive and finance committees of the board of directors. In addition, **W. E. Haines,** associate general counsel, was named secretary of the company.

Warren Lee Pierson has been elected chairman of the executive committee of the Wah Chang Corp. Pierson recently retired as chairman of Trans World Airlines, Inc., of which he remains a director.

Lee Ackerman of Western Gold & Uranium, Inc. has been elected president and a director.

Donald P. Shirra, formerly vice president and treasurer, was elected executive vice president. He continues as president of Grand Canyon Inn Corp., a wholly owned subsidiary. **Richard W. Ince** continues as chairman of the parent concern.

Ackerman was president of Lee Ackerman Investment Co., Inc., Southwest Savings & Loan Association, Lee Ackerman Securities Co. and Lee Ackerman Insurance Co.

Clarence E. Larson has been appointed a vice president of Union Carbide Nuclear Co. and general manager of Oak Ridge operations. He succeeds **Clark E. Center,** who will continue as a vice president on special assignment. Dr. Larson's association with the Oak Ridge operations extends back to 1943. He has been associate manager—research for Union Carbide Corp. since 1959.

John M. Mitchell, who has been in charge of international operations for Aluminum Co. of America has been named vice president in charge of the international department. **Samuel T. Gustina,** recently named con-

troller of the company, has been elected vice president.

R. E. Kendall was recently appointed to the newly created position of Canadian project manager of United States Borax & Chemical Corp. Formerly engineering manager at the company's Boron, Calif., plant, Kendall will be headquartered in Saskatoon, Saskatchewan, where U. S. Borax has been investigating potash permits held since 1957. He will coordinate the engineering and geological efforts of the U. S. Borax-Homestake Mining Co. joint venture to complete studies relating to possible large-scale potash production.

D. A. Underwood recently joined American Zinc, Lead & Smelting Co. to fill the newly created position of assistant director of minerals beneficiation. Underwood joined American Zinc in 1940 and served for 15 years in the chemical and metallurgical departments at the Metaline Falls, Wash., operations and also served for five years as mill superintendent at that location. During the past year he was on the technical service and development staff of Dow Chemical Co.

Omar J. Glantz, who for the past 4½ years has been director of research at the Nazareth, Pa., central laboratory of Penn-Dixie Cement Corp., has been appointed director of technical services. He will make his headquarters in the New York office. Glantz has been with Penn-Dixie for eight years, joining the company as plant engineer at Clinchfield, Ga., and becoming plant superintendent of Plant No. 2 in 1954.

Garvin Augustadt was recently named general manager of the Magma Copper Co. mine and the Magma Arizona Railroad at Superior, Ariz. He succeeds **Darrell Gardner,** who has retired. Gardner joined Magma in 1916. **Hubert J. Steele,** formerly assistant mine superintendent, has become general superintendent of Magma's Superior operations, succeeding Augustadt.

Otto C. Klein has been promoted to a newly created position as assistant director of research for American Zinc, Lead & Smelting Co. and its subsidiaries. Klein has been in the employ of the American Zinc Co. for the past ten years. Before that he spent 12 years with the Pigment Division of The Glidden Co.

George M. Meisel, ore beneficiation engineer, has joined Kaiser Engineers as a development engineer in the mining and minerals division. He will be responsible for development of new metallic and nonmetallic minerals engineering and construction projects for the company throughout the United States and Canada. Before joining Kaiser Engineers, Meisel was a project engineer for Kennecott Copper Corp.

David T. Pritchard has been named assistant manager for Mather Collieries Co., Mather, Pa. He was formerly with Island Creek Coal Co.

Harold L. Durrett has resigned as personnel manager for the Hanna Coal Co., Moundsville, W. Va., to join Walker Manufacturing Co., Harrisonburg, Va., in a similar capacity.

Evan Adams has been named general superintendent of Ireland mine, Hanna Coal Co., Division of Consolidation Coal Co. He had previously been maintenance superintendent. Adams succeeds **Clyde Gibson** who has become general superintendent of underground mines.

Stuart Nebeker has been appointed smelter operations superintendent of Kennecott Copper Corporation's Chino Mines Division. He replaces **Wesley C. Dow** who has been transferred to Kennecott's Utah Mines Division.

Nebeker, who has been at Chino for 2½ years, was a metallurgist with American Smelting & Refining Co. from 1943 to 1949 except for two years during World War II. From 1949 to 1958, he was a general foreman for the U. S. Smelting & Refining Co. Prior to joining Kennecott, he was a sales representative for Morris P. Kirk & Son, a subsidiary of National Lead Co.

Arthur L. Wells, Sr., has been promoted from general maintenance foreman to maintenance superintendent by U. S. Borax & Chemical Co., Carlsbad, N. M. At the same time, **Lewis Fairbanks,** formerly mine plant engineer, has been named assistant maintenance superintendent.

Ronald M. Coiner has been appointed instructor in the department of mining engineering at Virginia Polytechnic Institute.

Coiner, who graduated from the Virginia Polytechnic Institute in mining engineering in 1961, was formerly employed by the Olga Coal Co., Coalwood, West Virginia. In addition to his teaching duties at VPI, he will be engaged in research in coal preparation and mineral beneficiation.

OBITUARIES

Charles F. Ayer, 97, honorary board chairman of the Newmont Mining Corp., died September 23 in New Rochelle, N. Y.

Mr. Ayer started his mining career early in the century. He was associated with William B. Thompson who was chairman of Newmont Mining. He became president of Newmont which had large interests in Texas Gulf Sulphur and Continental Oil Companies, the Kennecott Copper Corp. and other companies.

At his death Mr. Ayer still held directorships in Newmont and in the Hudson Bay Mining & Smelting Co., Ltd.

He had also been a vice president and director of Texas Gulf Sulphur and president of the Magma Copper Co. He was the original president of the Boyce Thompson Institute for Plant Research in Yonkers, and the Boyce Thompson Southwestern Arboretum of Superior, Ariz. Both organizations were founded by Mr. Thompson. Mr. Ayer was chairman of Newmont from 1947 to 1953.

E. A. Schroer, 67, former mill superintendent at Chino Mines Division, Kennecott Copper Corp., died August 2 in El Paso, Texas. Mr. Schroer was in the mining industry for 43 years beginning in 1915 with Butte-Superior Mining Co. in Butte, Mont., and coming to Chino in 1922. He retired in 1958.

George A. Morris, 51, fuel engineer with Pickands Mather & Co. for the past ten years, died in Cleveland, Ohio, on August 18. Before joining Pickands Mather, Mr. Morris had been with Virginia Smokeless Coal Co. and had also served Union Carbide Corp. and the Norfolk and Western Railway.

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NEWS and views

Large Coal Producer to Extract Alum from Mine Waste

North American Coal Corp., a leading producer of bituminous coal for almost half a century, is poised to enter a new and promising field.

By the end of 1961 the Cleveland-based company's new chemical processing plant, now under construction on the Ohio River, is expected to be in full-scale commercial operation. Its end product is alum, or aluminum sulfate, used by the paper and pulp industry in water-proofing and by municipal and industrial water treatment plants to aid in water purification. First commercial shipments of the aluminum sulfate output, to be marketed in both granular and liquid form, are scheduled to be made in January.

North American broke ground for the $2,000,000 alum-producing plant last March at Powhatan Point, Ohio, some 20 miles downstream from Wheeling, W. Va.

According to H. G. Schmidt, president of North American, the company's hopes for a brighter future are sustained by an exclusive new process which will be used to produce the alum. The process was developed in cooperation with Strategic Materials Corp. of Niagara Falls, N. Y.

Key to the method is use of material which North American for years discarded as waste in its coal mining operations. The ore lies in a band above the coal seam and contains alumina, the raw material for making aluminum. Some 10,000,000 tons of the now-important alumina-bearing material is presently above ground on sites adjoining the new plant, and many more millions of tons are in the ground. The aluminum sulfate will be produced by combining the former waste material with sulfuric acid.

The company is already designing a production plant to convert alum to alumina (aluminum oxide), which would expand market outlets to include primary aluminum producers. North American reports that the technical feasibility of the process has been established.

Ammonium Nitrate to be Studied

An extensive research program into the fire hazards of ammonium nitrate and related materials will be undertaken by the Bureau of Mines under a cooperative agreement with the Manufacturing Chemists' Association, Inc. The research project is expected to begin soon and will run for one year, with the entire cost of $60,000 borne by the Association. The agreement provides for an extension beyond the one-year period if necessary.

The research will cover not only the fire hazards of ammonium nitrate, but of such related systems as nitric acid-hydrocarbon, ammonium nitrate-urea, and combinations of these systems. The Bureau will study the effect of contaminants, and of confinement on the detonability of solid and molten ammonium nitrate and evaluate its sensitivity to initiation by the close proximity detonation of other explosive systems.

Bituminous Coal Research Occupies New Laboratory

Bituminous Coal Research, Inc. has consolidated its Columbus, Ohio, and Pittsburgh research activities in the coal industry's new research center at Monroeville, Pa. All BCR activities are now centered in the laboratory at Monroeville, 14 miles east of downtown Pittsburgh, under the direction of James R. Garvey, vice president and director of research.

The research center, with its equipment, represents an investment of more than $1,000,000. Funds were contributed primarily by the coal industry, with substantial aid from electric utilities, other major coal users, and companies which supply materials and equipment to the coal industry. The research program will emphasize development of improved coal utilization methods and equipment. The new laboratory can accommodate a staff of 80 to 100, depending on the nature of research being conducted.

The main research building consists of a chemical and engineering wing with individual laboratories and offices; a service area with a coal technology library, management offices and a cafeteria and auditorium; and a full-scale tests area with shop, stockroom and related services. A smaller building houses coal preparation facilities, chemical storage and a garage.

Flintkote Awards Quarry Development Contract

McNamara Construction Co. of Newfoundland Ltd., has been awarded a contract by The Flinkkote Co. to develop facilities at its Flat Bay quarries in Newfoundland. The contract, between $1.5–$2,000,000, provides for completion of a six-mile long aerial conveyor from the existing quarries at Flat Bay to Turf Point and construction of pier facilities at Turf Point. A crushing building and related conveyor system also will be built at Flintkote's Flat Bay quarries.

Flintkote earlier this year signed an agreement with the Province of Newfoundland permitting Flintkote under a 99-year renewable lease, rights to develop gypsum deposits in the Flat Bay area having proven reserves of 15,000,000 tons of gypsum and subsequently to an area comprising nearly 3000 sq miles.

The main construction now completed at the new Koppers Research Center in Somervell Park, Monroeville, Pa., is pictured in this aerial view. The center can accommodate some 450 scientists and their assistants. When all other buildings planned for the 176-acre site are completed, the center will house about 1500 people.

Koppers Dedicates Research Center at Monroeville, Pa.

Koppers Co., Inc. has announced the dedication of its newest and largest research facility, at Somervell Park, Monroeville, Pa. It represents an investment of approximately $8,500,000.

Koppers, a 49-year-old company with annual sales in excess of $300,000,000, began to accelerate its research program about 15 years ago when it moved into chemicals and plastics. Until that time the company had been largely identified with engineering and construction—mostly in the steel industry; coal by-products, wood preserving, fabricated metal products and merchant coke plants. Their new facility will be the headquarters of the company's research department.

Only about one-third of the buildings planned for the 176-acre site have been completed. No firm schedule for construction of the remaining buildings has been set.

The center consists of a five-story administration building, three 3-story interconnecting laboratory wings and several outlying auxiliary buildings. A feature of the center which contributes to its easy expansibility are the glass enclosed stairways at the end of each wing which can be easily removed when additions are called for, and reaffixed to the end of the new wing.

Island Creek Develops New Mine

Raymond E. Salvati, chairman and chief executive officer of Beatrice Pocahontas Co., has announced that the company has made an award to Dravo Corp. of Pittsburgh for the sinking of three shafts on the company's property in Buchanan County, Va. The sinking of these shafts is the first step in the development of a new mine being designed to produce 1,200,000 tons annually of Pocahontas No. 3 seam coal.

It is estimated that it will require 15 months to complete the three shafts, each of which will be approximately 1400 ft deep; also that more than 85 men will be employed locally on this phase of development.

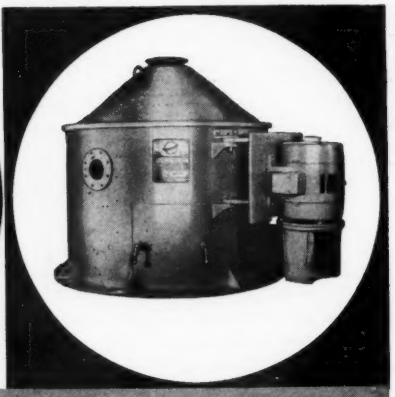
Beatrice Pocahontas Co. is a newly-formed company jointly owned by Republic Steel Corp. of Cleveland and Island Creek Coal Co. of Huntington, W. Va.

New Mine to be Developed By Cannelton Coal Co.

Cannelton Coal Co., has appropriated in excess of $1,200,000 for expansion of their coal mining operations located at Cannelton, W. Va.

Included in the appropriation is the development of a new mine, to be known as No. 8 mine, in the Eagle seam and additions to the facilities of the Lady Dunn coal preparation plant. Work has already started on shafts for the new mine and additional contracts are expected to be signed in the near future. Completion of the project is expected in early 1963. However, the major part will be completed within the next 15 months.

THE C·M·I COMPACT 26



NEWEST ADDITION TO THE CMI LINE OF CONTINUOUS CENTRIFUGAL DRYERS

The all new CMI Compact 26 is the first compact dryer for moderate requirements; the first compact dryer specifically made for a capacity of 20 tons per hour or less of coal or minerals; the first compact at a modest price.

Send for Bulletin 26 which contains complete information.

CMI CENTRIFUGAL & MECHANICAL INDUSTRIES, INC.

146 PRESIDENT STREET • ST. LOUIS 18, MISSOURI

Coal is expected to be produced from the No. 8 mine by October 1962.

Cannelton is a subsidiary of the Algoma Steel Corp., Ltd., of Sault Ste. Marie, Ontario, Canada, and furnishes them with their requirements of metallurgical and by-product coal.

ALSO . . .

A group of major producers of pig iron have established a fund with the Gray Iron Founder's Society to finance a four-year technical and economic survey of current and future uses for gray and ductile iron castings. The Society has contracted with Battelle Memorial Institute, Columbus, to conduct the initial fact-finding study, to pinpoint both problems and opportunities confronting the country's 1950 gray iron foundries.

The Tennessee Valley Authority announced the awarding of contracts for 3,503,600 tons of coal, valued at $10,339,631. The coal, to be delivered over periods ranging from six months to three years, comes from five major coal fields; East Tennessee, 374,100 tons; Virginia, 294,000 tons; Southeast Tennessee, 172,800 tons; western Kentucky, 1,619,200 tons, and southern Illinois, 1,043,500 tons.

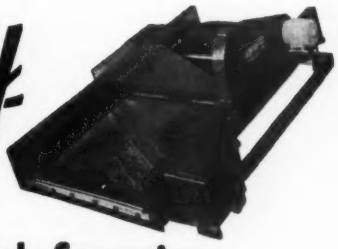
Virginia Polytechnic Institute held a one-week summer program for high school students to develop interest in minerals education. Students attended lectures by the mining, metallurgy, geology and ceramics staffs and visited area mining operations. Of interest to the group were operations of the National Gypsum Co., New Jersey Zinc Co., and Consolidation Coal Co. The Women's Auxiliary of the AIME was instrumental in planning the meetings. The program hopes to aid in showing the trend to lower enrollments in the mineral education fields.

The Fifth Rock Mechanics Symposium will be held at the University of Minnesota, May 3–5, 1962. Jointly sponsored by the mining departments of the Colorado School of Mines, the Missouri School of Mines & Metallurgy, the Pennsylvania State University, and the University of Minnesota, the Symposium will deal primarily with problems of "dynamic" rock mechanics, although significant advances in other areas will also be included. It is tentatively proposed to hold five technical sessions in the 2½-day meeting devoted to the following topics: drilling, blasting, comminution, "Dynamic" physical properties of rocks, theories of rock failure and "static" physical properties of rock, and general (important contributions, as determined from papers submitted for consideration). Papers are now being solicited. Registration details will be available later from the Center for Continuation Study, University of Minnesota, Minneapolis 14, Minn.

Kennecott Copper Corp. has announced the location of its new basic research laboratory at a site in the Lexington Park section of Lexington, Mass. The site is located near the intersection of Routes 2 and 128, 15 minutes from downtown Boston. Kennecott's research program will emphasize solid state physics of metals. The company, the world's largest producer of copper, already has extensive applied research programs for improving the quality of fabricated products, and developing new fabricated products. These programs are under way in the Kennecott research center at Salt Lake City,

(continued on next page)

THE Leahy HEAVY DUTY VIBRATING SCREEN



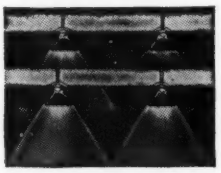
Fine Mesh Screening to Meet Your Every Need.

The versatile Leahy® No-Blind Vibrating Screen handles just about any screening you need in the $-\frac{1}{4}$" range . . . dry, wet or damp.

When dust is a problem, totally enclosed dust-proof models are installed . . . and when damp or sticky materials must be screened integrated FlexElex® jacket heating is available.

The Leahy screen is made in twelve standard sizes from 1′6″ x 3′ to 5′ x 8′, with single or double surfaces and in open or enclosed type.

Operating and maintenance costs are exceptionally low. Send for Bulletin 15-J.



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These handy nozzles are simple, flexible and economical. All you do is drill oversize holes in spray line, one per nozzle, clamp on and get results. They can be definitely aligned for washing, sluicing or spraying according to need. They are removed or replaced in a moment's time.

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CONCENCO PRODUCTS

★ *The ORIGINAL Deister Company • Inc. 1906*

(continued from previous page)

Utah, and at Kennecott's fabricating subsidiaries, Chase Brass & Copper Co., Waterbury, Conn., and The Okonite Co., Passaic, N. J.

The new research initiative is aimed at obtaining fundamental knowledge and the discovery of new scientific facts pertaining to the metals industry.

More water is used to produce a ton of copper, on the average, than to produce a ton of any other major metal, the Interior Department reported in a recent study. During the year covered by the study, the copper industry used about 330,000,000 gal of water a day in the mining and manufacturing of primary copper—.3 percent of the total estimated withdrawals of industrial water in the U. S. that year. A large part of this amount was used in Arizona, Nevada, New Mexico and Utah, where about five-sixths of the domestic copper is mined. These States are all in an area where water supplies are limited. Much of the remaining water use was near New York City, where most of the electrolytic refineries are located. It was found that a little more than 100,000 gal of water was used in the production of a ton of copper from domestic ores.

Banks, insurance companies and industrial concerns are investigating the salt mines of Hutchinson, Kans. Concerned over the possibility that their records will be destroyed during nuclear warfare, these businesses hope to store vital documents, microfilm and blueprints in the 150-mile network of salt mines 645 ft under the city.

More than 60 firms are currently using the plan which was launched by a group of Kansas businessmen who took a 99-year lease on the tunnels. The 128-acres of mine tunnels are three times deeper than an H-bomb crater. The mine temperature is a constant 68° and shelves and cabinets protect against mildew and insects. Two industrial firms also have plans for relocating their headquarters in the mines. Model suites are on display with offices, a conference room, kitchen and bedrooms.

Bell & Zoller Coal Co. has closed its Moss Hill mine. Moss Hill is a small drift mine located near Morton's Gap, Muhlenberg, Ky. The mine's small size made it uneconomical for the company to continue operations and the remaining coal reserves have been sold to another company for strip operations. The Moss Hill mine has in recent years accounted for less than five percent of the company's annual production.

WHEELS OF GOVERNMENT
(continued from page 95)

approved a bill which would enact into law revised tariff classification schedules recommended last year by the Tariff Commission. The measure will come before the House in the next session.

During committee consideration of this bill, the American Mining Congress adopted a strong resolution in Seattle urging prompt action—which was immediately wired to the Ways and Means Committee.

The Commission's recommended schedules were prepared pursuant to the Customs Simplification Act of 1954. Under that Act, the Commission was directed not to make changes in rates of duty except in those instances where, in the judgment of the Commission, incidental rate changes were necessary to accomplish the purpose of simplification.

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ALLOY CAST STEEL MINE CAR WHEELS AND HIGH PERFORMANCE PARTS

MADE OF F 85 ALLOY CAST STEEL

Essential parts for every mining operation, cast from finest carbon and alloy steels.

Wheels and Rollers • Sheaves and Wire Rope Fittings • Chain, Sprockets and Buckets . . .

Far from ordinary, these highly specialized mine car wheels, electric furnace cast of F85 alloy steel, are establishing new performance and service life records in actual use. A Brinell of 350-400 is provided on treads and flanges with a high degree of ductile toughness in hubs and webs.

You'll want complete information on all F-C wheels and parts for mining. WRITE TODAY!

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COAL DIVISION

CONFERENCE

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The most valuable one-day mining industry meeting of the year, the AMC Coal Division Conference will be jam-packed with usable information on a wide variety of mining problems. Just look at the topics to be discussed.

All mining men and mine equipment manufacturers are invited!

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UNDERGROUND POWER

Cables and Cable Accessories for A-C Mining . . . . Improving Trailing Cable Performance . . . . Electrical Symbols for the Mining Industry . . . . Permissibility Problems

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MINE HAULAGE

Safety Code for Coal Mine Transportation

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ROOF ACTION

The Cost of Supporting Mine Roof . . . . Standard Specification of Roof Bolting Materials

*

SAFETY

Fire Resistant Hydraulic Fluids

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MECHANICAL MINING

Dust Control with Continuous Mining Equipment . . . . Aptitude and Achievement Testing . . . . Cost Controls

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COAL PREPARATION

Filtering Froth Flotation Products . . . . Preparation Plant Maintenance

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RESEARCH

Functions of the Office of Coal Research

Get DOUBLE EXPANSION for DEPENDABLE roof support with PATTIN roof bolts and expansion shells

STYLE D-1

The unique double expansion feature of all Pattin expansion shells insures *dependable* roof support, in hard or soft roof conditions. Their double holding power guards against failure — even under a 20 ton pull!

Pattin features include a parallel contact with the hole, and no definite drilling depth is required, as the shell can be securely anchored at any place in the hole. They anchor solidly and will not turn while being tightened. Wedge and shell are assembled in a manner to prevent loss of parts in handling, and the bolt and shell assembly are furnished as a complete unit. Plates are bundled separately. No special nuts or ears are required on the bolts. These features make a safer roof — and a safer roof means fewer accidents, increased production, more clearance for equipment operation and better ventilation.

Pattin specializes in roof bolting — it's our business, not just a sideline! Your business is important to us, and our service engineers are always available for consultation on your roof problems — ready to give you service when you need it! WRITE OR PHONE US TODAY for complete details.

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The PATTIN split-type BOLT

The split-type bolt is one of the first slotted bolts, and continues to be a favorite wherever split-type bolts are used. Many mines still prefer this type. The bolt is a full 1-inch in diameter, with cut threads and furnished with hex or square nuts and various size plates and wedges.

IN WESTERN STATES

Pattin expansion shells are available and serviced exclusively by Colorado Fuel and Iron Corporation, Denver, Colorado. Western mining companies should contact them direct for information and consultation.

PATTIN

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The PIONEER of roof bolting . . . established 1888

ALSO . . .

Consolidation Coal Co. has purchased physical assets and leased coal at four mines of the New River and Pocahontas Consolidated Coal Co., at Berwind, McDowell County, W. Va. The mines have an annual production totaling about 200,000 tons and adjoin the property already owned by Consolidation Coal at Amonate, Va.

Union Switch & Signal, Division of Westinghouse Air Brake Co., has delivered to Transportation Services, Inc., a set of inductive control equipment for remotely controlling the movements of an unmanned diesel-electric switcher locomotive to be installed as part of a pushbutton rail-to-barge coal transfer facility at Florence, Ala. This system provides for throttle control, brakes, movement in either direction, automatic uncoupling, sanding and bell ringing.

The U. S. Bureau of Mines has opened bids for special cleaning equipment to be used in tests connected with the experimental operation of a coal-fired gas turbine. Known as electrostatic precipitators, the devices will be tested for their ability to remove fly ash from hot gas leading to the turbine. The experimental turbine—loaned to the bureau by the locomotive development committee of Bituminous Coal Research, Inc.—now is being rebladed in preparation for operation. One of the major problems connected with development of a suitable coal-fired gas turbine is the control of ash to minimize wear on the blades.

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BILL'S COMPANY INSTALLED
MOORE LOCKERBASKETS!
Bill's work clothes and the clothes he wears to and from the plant are cleaner and fresher now — with lockerbaskets they're exposed to moving air and light, no more damp, musty locker odors. Lockerbaskets save space and money, too! Get all the details by writing Department B.
THE MOORE COMPANY
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TIMBERED AREA COLLAPSED... BUT YIELDABLE ARCHES HELD

Here's a dramatic example of Yieldable Arches doing their job. Men were re-timbering the roof in the foreground when a large fall occurred. The tunnel was destroyed in the timbered area, right up to the edge of the Yieldable Arch installation. The Arches yielded, and sagged a bit . . . but they held!

One look at the picture, and you can't help wondering how such relatively slim members could support the crushing weight. The answer is: it's not the *strength* of the Yieldable Arch that does the trick, it's the *give*. By yielding a little at a time, the Yieldable Arch gives the overburden a chance to arch over and establish equilibrium, thus in large measure sustaining itself.

A Yieldable Arch set is built up of three or more U-shaped rolled-steel segments which nest together at the ends to form a friction joint. Stout U-bolt clamps secure this joint and hold it fast under normal loads. Excessive pressures will overcome the friction in the joint, however, permitting the Arch to give gradually. Horizontal struts act as spacers and provide lateral rigidity to the structure.

Most mines have found that Yieldable Arches pay for themselves in their first year of service. They can be installed by your own men, and have high salvageability. Let one of our engineers discuss them in detail with you.

Just get in touch with our nearest office.

Steel *for Strength ... Economy ... Versatility*

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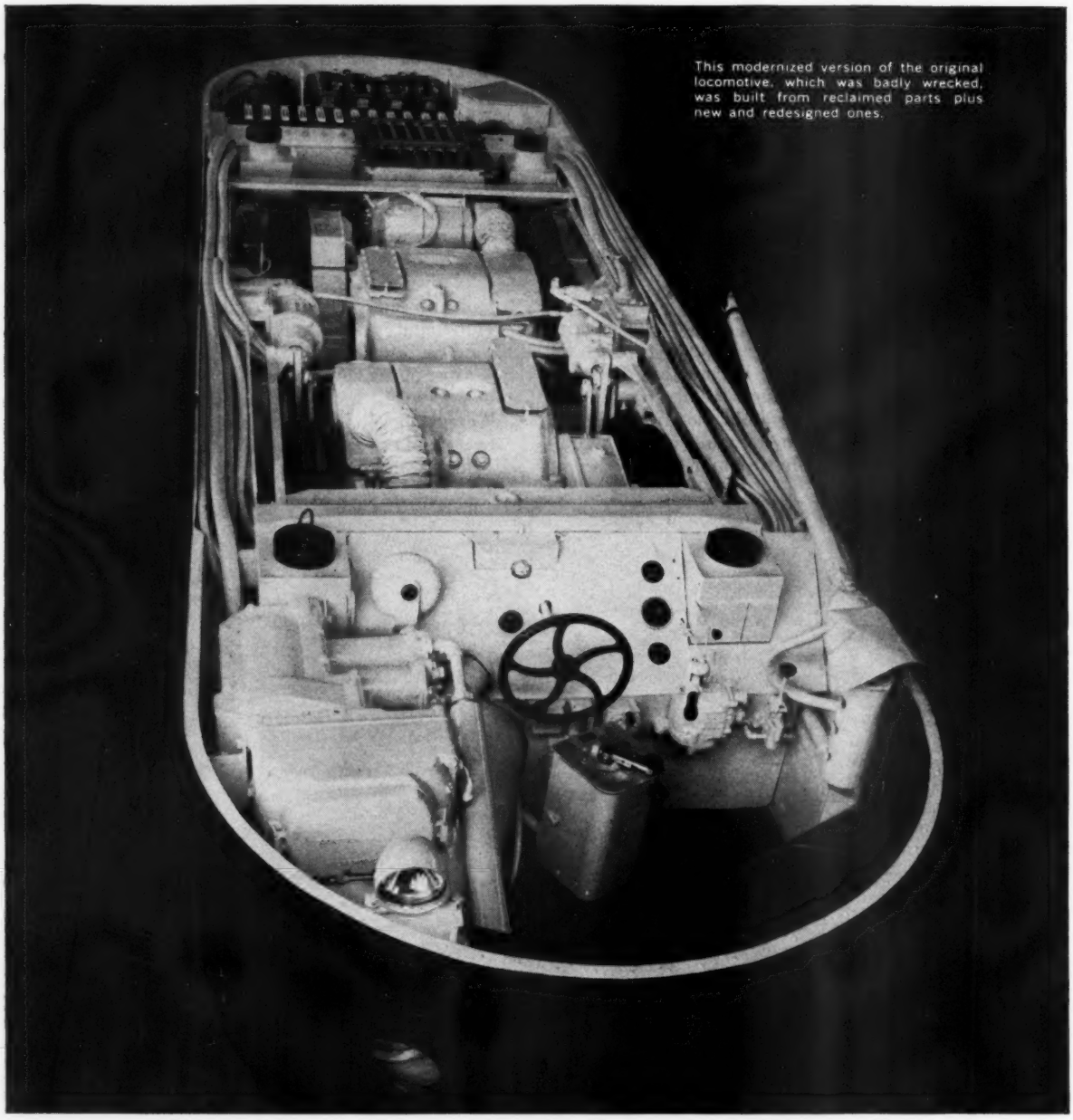

This modernized version of the original locomotive, which was badly wrecked, was built from reclaimed parts plus new and redesigned ones.

NATIONAL'S COMPLETE REBUILDING SERVICE MODERNIZES MINE LOCOMOTIVE

This 24-ton locomotive was delivered to National's plant completely wrecked. Redesign and complete rebuild by National to new equipment standards included bumpers, air brakes, contactors, low voltage control system and other major modifications. National not only rebuilds mobile underground mining equipment but incorporates newest developments. Motor windings, for instance, have the latest and best grade insulation tailored by National to increase the work the whole locomotive can do. For unmatched service in mining machinery repairs, check your National field engineer or contact National Electric Coil... Bluefield, W. Va., or Columbus, Ohio... or National Electric Service Corporation . . . Harlan, Kentucky.

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DIVISION OF McGRAW EDISON

NEWS and views

USBM Lead and Zinc Research for Fiscal 1962 Outlined

The Bureau of Mines has outlined a number of research programs for lead and zinc that will be conducted during the current fiscal year. Included in the mining studies will be laboratory and field tests in the Coeur d'Alene region of Idaho on rock-pressure problems associated with deep mining. The effectiveness of precast, segmented, reinforced concrete drift sets, explosive shaping of rock bolts to obtain rapid rock-bolt anchorage and factors affecting ground support of hydraulic stope fill will be tested. Ways to reduce costs and to increase safety and efficiency of rock-drilling operations and breakage of rock with explosives will also be sought.

Among metallurgical projects that will be conducted are the following: Use of microorganisms in extracting lead and zinc from marginal ores, use of radioactive tracers in leaching studies, application of ultrasonics in electrodeposition of metals, and recovery of lead and zinc from complex ores, slimes and mill tailing by flotation or chemical methods.

Hecla May Operate Mayflower Mine

New Park Mining Co. and Hecla Mining Co. have entered into an agreement under which New Park's Mayflower mine at Park City, Utah, may come to be operated by Hecla. Hecla is currently making an examination of the property and plans an extensive development program if results of the study are satisfactory. A new mill has been under consideration by New Park, which in 1960 produced about 50,000 tons of ore, and would be one phase of the development.

Expansion Will Extend Pima Life

Pima Mining Co. is making plans that will extend the life of the company's open pit copper mine near Tucson, Ariz., to 1975 or later. One phase of the program would involve exploitation of low-grade reserves that lie east and northeast of the present pit. About 20,000,000 tons of reserves containing 0.65 percent copper have been established in the low grade area. In the present pit, there are about 8,000,000 tons of 1.5 percent copper of Banner Mining Co. ore to be mined and milled by Pima by agreement between the two companies. Pima will open a new pit which eventually may be merged with the present pit.

Pima also has plans that call for doubling concentrator capacity to 7000 tpd and enlarging crusher ca-

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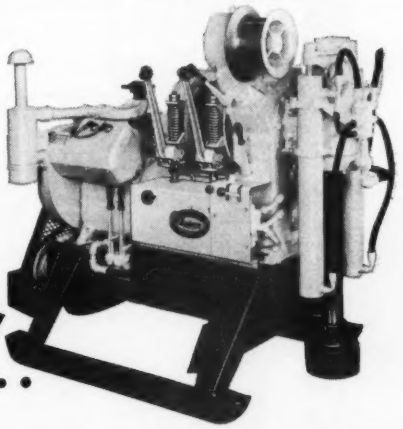
IT'S A FACT

NEW Longyear "38" Drill works anywhere, goes anywhere...



ALL THE FEATURES drillers have asked for are combined in the new Longyear "38" Diamond Drill. Finger-tip controls and a wide range of optional equipment put the operator in complete command. Ideal for all kinds of mineral exploration jobs, blast hole drilling and site development work. The versatile "38" has new low-range speeds, optional built-in Wire Line Hoist and hydraulic retraction. Features compact design with lightweight chassis breakdown for easier transporting. Capacity, 2800 ft. with AW rods. For information, contact our nearest office.

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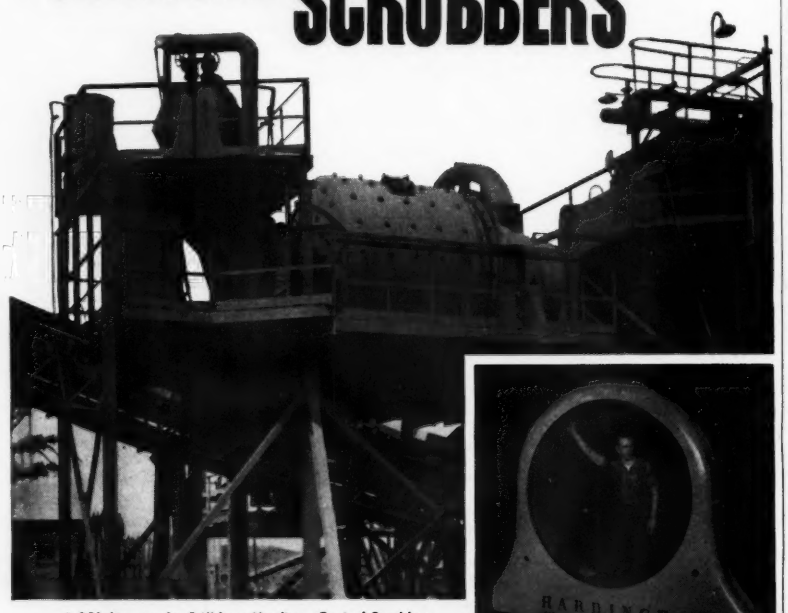
The large diameter, short-length trunnions used on Hardinge Conical Scrubbers permit chute feeding of unsized ore and rock at rates up to 800 tons per hour. The superincumbent mass action of the charge quickly slurries the clay and dirt, permitting ready separation on washing screens or trommels.

Hardinge Scrubbers are in wide use in cleaning such diversified materials as limestone, phosphates, iron ore, river gravel, ganister rock, dolomite, abrasives, and in separating clay from rock and gravel.

HARDINGE CONICAL SCRUBBERS



A 10' diameter by 84" long Hardinge Conical Scrubber scrubbing 5" iron ore.

A Hardinge Scrubber bearing—inside diameter 60".

Ask for Catalog 37-B-52

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BIRMINGHAM

(continued from previous page)

pacity to 8000 tpd. The entire project, which will take about a year to complete, will get under way sometime next year and involve expenditures of $4,000,000.

Utah Construction to Investigate Iron Prospect

Pinnacle Exploration, Inc., and Utah Mining & Construction Co. have entered into an agreement calling for exploration and development of the "Crypto" iron ore prospect near Milford, Utah. The prospect has been the subject of geophysical study by Pinnacle for the past three summers. Utah Mining & Construction, which has an option to purchase the property, is expected to initiate a drilling program in the near future. Pinnacle is an 80 percent owned subsidiary of Callahan Mining Corp.

Proposal to Purchase MiVida Mine Advanced

Freeport Sulphur Co. is reported to be negotiating for the purchase of the MiVida mine in the Big Indian District, San Juan County, Utah, and the mill and mine properties of Uranium Reduction Co. Charles A. Steen owns the MiVida and his company, Utex Exploration Co., controls 36 percent of Uranium Reduction Co. stock. Other owners of Uranium Reduction include Hidden Splendor Mining Co.; American Zinc, Lead & Smelting Co., and the Millbank interests of New York. Freeport is reported to be offering in the neighborhood of $25,000,000 for the properties involved.

ALSO . . .

The Leadville, Colo., smelter of American Smelting & Refining Co. has been sold to a Los Angeles auctioneering company. The smelter was closed early this year.

A beryllium deposit consisting of 52 patented claims and 60 unpatented claims, known as the California mine and located on Mount Antero near Salida, Colo., has been leased to U. S. Beryllium Corp., owner of the Boomer beryllium mine on Badger Flats. The vein system in this new group of deposits is said to resemble that existing in the Boomer. U. S. Beryllium controls about two square miles of claims in the Badger Flats area, which is considered to be a promising beryllium mining area.

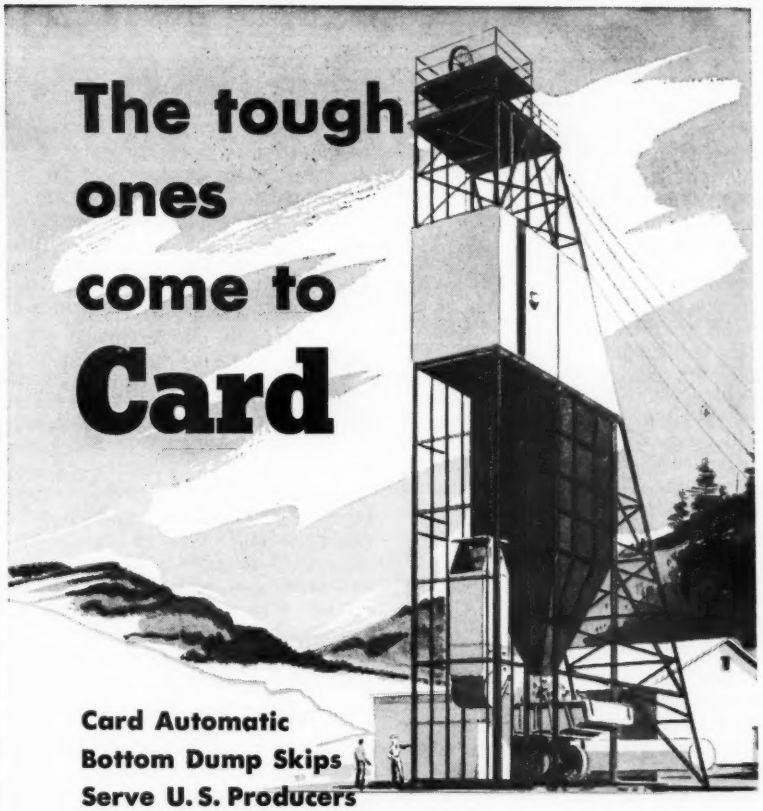
The Schwartzwalder mine of Denver-Golden Corp, near Golden, Colo., is being deepened by 300 ft Shipments of uranium ore from the mine during the last fiscal year totaled about 20,000 tons with grade being about 0.72 percent U_3O_8.

United States Borax & Chemical Corp. and Homestake Mining Co. have entered into a joint venture to complete studies relating to possible large scale potash production in Saskatchewan, Canada, where U. S. Borax has been investigating permits held since 1957. If the completed studies indicate the technical and economic feasibility of a Canadian potash operation, the two companies may participate equally in any company formed for such purpose. One or more additional associates may also be invited to participate in the future.

Sinking of the Sunshine mine No. 10 shaft of Sunshine Mining Co. near Wallace, Idaho, is underway and expected to be completed by the end of this year. The company has revised its original plans and will now sink to 1850 ft below sea level, which is below present mining depths in the Coeur d' Alene district. New working levels will be established at the 4200, 4400 and possibly the 4600 ft points. The 4000-ft level is the present deepest working level in the Sunshine.

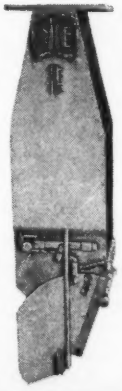
Rare Metals Corp. of America, operator of a uranium mill at Tuba City, Ariz., has successfully bid for three autoclave vessels and related equipment from the Atomic Energy Commission's Monticello, Utah, mill. The bid was $24,827.66. The Monticello mill has been closed for 1½ years and the property and equipment declared surplus. The AEC is selling the mill and equipment on a negotiated sales contract basis.

A concrete batching plant that produced all concrete for the Trinity Dam project in California has been released for liquidation. The equipment includes a 240-ton aggregate storage bin in five compartments complete with aggregate conveyor, 1500 cu ft overhead bulk cement silo, cement bucket conveyor and screw conveyor, two 2-yd Smith tilting mixers, and 200 gal automatic water scale. Aggregates and cement are batched automatically into a two-yd dual batcher. For further details contact Trinity Dam Contractors, Eastside Road, Redding, Calif.



Card Automatic Bottom Dump Skips Serve U. S. Producers in most Major Mining Areas

This is a progress report on a relatively new idea. Beginning in 1956, increasing demand for the new Card automatic bottom dump skips has gradually brought them into service in a majority of the nation's principal mining areas—from Arizona to the Canadian line. In a typical operation two of these Card skips of approximately 150 cu. ft. capacity each are used to haul ore up a thousand-foot three-compartment shaft at a rate in excess of 900 tons per day.



In the initial year of operation, in one such installation, these automatic skips carried over 270,000 tons of rock before needing attention other than routine maintenance. The same successful design will prove out in your next project. It can be adapted to any capacity and specifications with ease.

Tell us your requirements.

C.S. Card Iron Works Co.

2501 WEST 16th AVE.
DENVER, COLORADO

Manganese, Inc., has closed its manganese mine and processing plant at Henderson, Nev. The plant has been producing manganese for the national stockpile, but further purchases for this purpose by the Government are not contemplated. The company is a subsidiary of Howe Sound Co., which will try and sell the plant.

An expanded shale plant is under construction by Susquehanna-Western, Inc., near San Clemente, Calif. Scheduled for completion in January 1962, the million dollar plant will produce 1000 cu yd per day of expanded shale for use as aggregate in concrete. The plant is located on a 400-acre site where the shale will be mined.

Employes of Kennecott Copper Corp. established a new Utah Copper Division single plant safety record in July when refinery employees had worked 2,005,973 man-hours without a disabling injury. The last disabling accident at the refinery occurred in June 1960. The new record surpasses one involving 2,003,776 man-hours set at the Magna concentrator in 1942.

Natomas Co. expects to begin gold-dredging operations in Peru in July 1962 as a result of recent legislation passed in that country. A dredge for this purpose will be rehabilitated and shipped to Peru within the next few months. Sufficient yardage to assure a long dredging life has been established in a concession area by testing and drilling. The company's exploration program in South America is aimed at developing additional gold-bearing areas that will eventually utilize all of its idle dredge capacity.

Completion of Colorado Fuel and Iron Corporation's Oxygen Steelmaking Plant at Pueblo, Colo., has entered its final phase, with burning-in and hardening of the lining of the second of two oxygen-steel furnaces. The No. 1 furnace produced its first heat of oxygen steel in mid-July and since the first of August has been operated daily. Heats tapped have averaged 70 to 80 tons of low carbon steel. High carbon heats will be produced in the future. The new plant is part of a $21,000,000 expansion and modernization program.

DMBD Mining Co. has installed a 50-ton flotation concentrator at Mammoth, Ariz., for treating molybdenum bearing copper ores from the Childs-Alwinkle mine at Copper Creek. The company has been mining at Copper Creek for about two years.

Construction has begun on a 500-tpd uranium processing mill in the Shirley Basin of Wyoming for Petrotomics Co., which is a joint partnership venture of Kerr-McGee Oil Industries, Inc., and Tidewater Oil Co., and its associates. Scheduled for completion in April 1962, the mill will treat ores from the partnership's deposits in the Shirley Basin. Petrotomics has a contract with the Atomic Energy Commission which provides for the sale of ores and concentrates from the operation through 1966.

Seventy eight employes of Chino Mines Division, Kennecott Copper Corp. have received Joseph A. Holmes safety awards. This award is given to encourage safety in the mining industry and is given to personnel who have worked for 20, 30, or 40 years without a lost time accident. To date 243 employes at Chino have received the awards.

The 42 LB.
GRIPHOIST
TIRFOR
LIFTS • PULLS
LOWERS
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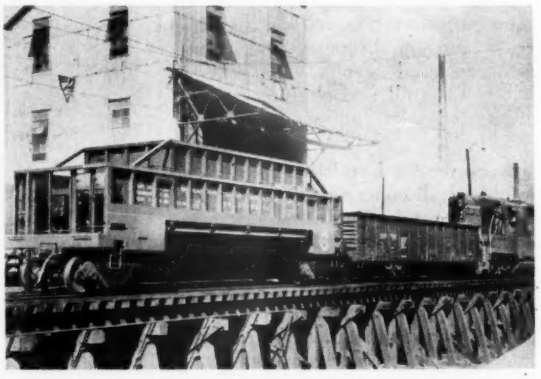
Single Line
Capacity increased to 6 TONS with pulley blocks
Replaces chain hoists, air hoists, winches . . less cost, less maintenance. Unlimited cable travel, portable, hand operated . . faster, cuts rigging time . . unmatched safety record.
One Year Guarantee
Preferred on job after job, in construction, refineries, oil drilling, plant erection and maintenance, mining, machinery moving, trucking, etc.
GRIPHOIST, INC.
744 Harrison St., San Francisco 7, Calif.
334 Granite Ave., Boston (Milton 86), Mass.
½" wire rope
3,300 LBS.
SEE YOUR LOCAL DEALER

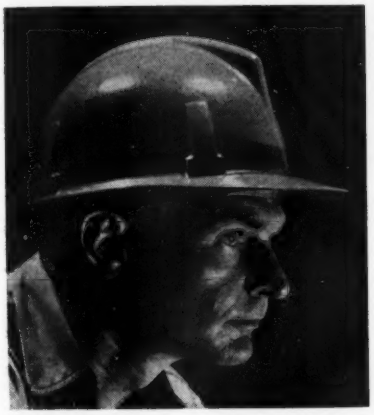
Kaiser Engineers has been awarded a contract for the engineering and design of the $2,000,000 bulk loading facility at the Port of Long Beach, Calif. The bulk loader, which will be the largest facility of its type on the Pacific Coast, at full capacity will be able to load 2800 tph of iron ore. It is expected to handle about 2,000,000 tons of iron ore, petroleum coke, potash, coal and mill scale during its first year of operation. The bulk loader is to be constructed on a 300,000 sq ft site where a traveling loading gantry will be capable of traversing a 600-ft length of the pier front.



Forty bottom-dump gondola cars of a new design and specifically for handling copper concentrates and similar substances will be placed in service by Southern Pacific Railroad. The new cars have sides which slope outward at the bottom; specially painted sandblasted interior surfaces; and pneumatically-operated doors designed for rapid discharge. There are special neoprene seals around the doors that eliminate the need for hand sealing.

manufacturers forum

INDUSTRIAL SAFETY HATS AND CAPS — injection molded with polycarbonate, one of the newest of the



exotic high impact engineering thermoplastics—have been announced by Mine Safety Appliances Co., Pittsburgh. Pa. Known as the Topgard hat line, they are believed to be the most advanced head protection available where there is danger of falling objects in industries such as mining, engineering, construction, material handling, steel production, metalworking, and quarrying.

Lightweight and designed with a single ridge construction to help deflect the force of a falling object, the new headgear complies with Federal and with American Standards Association specifications.

A POLYVINYL CHLORIDE SOLID WOVEN MINE CONVEYOR BELT in a distinctive red color is announced by Raybestos-Manhattan, Inc., Manhattan Rubber Div., Passaic, N. J. Specifically designed for underground service, the new belt conforms to the U. S. Bureau of Mines specifications for fire resistance. New techniques in controlled-tension weaving result in improved, lighter, and more uniform belt construction. Solid woven nylon and cotton strength members and an interlocked weave provides tear resistance and fastener holding strength. Solid woven edge eliminates ply separation. Both sides of the belt have a bright red PVC cover that make it highly resistant to abrasion. Either side can be used for conveying. The belt is moisture proof.

A PORTABLE ELECTRIC WINCH-HOIST with a single line pull of 4000 lb is offered by City Engineering Co., Inc., 3547 Massachusetts Ave., Indianapolis 18, Ind. Called the My-te Super, the unit is 13 in. wide by 12½ in. long by 11 in. high, and weighs 160 lb. It is powered by a 110-volt, single phase, 60-cycle a-c motor. Drum capacity is 325 ft of ⅜ in. cable, or 185 ft of ½ in. cable. Free load speed is 15 rpm. Included are 15 ft of 110-volt cable with heavy duty plug, and a ten-ft remote control cable with forward and reverse switch.

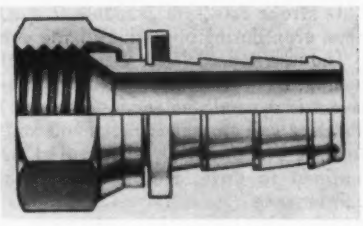
A NEW TYPE OF ROOF PINNER is currently being introduced to the mining industry by the Gardner-Denver Co., Gardner Expressway, Quincy, Ill. The D73HRR performs all phases

of the roof pinning operation and is designed to drill the hole, insert the roof bolt and tighten the bolt to the required torque. The tool also incorporates an independent hydraulic rotation motor, and has its own pneumatic feed motor to feed the drill steel into the hole, plus a pneumatic centralizer for maintaining proper steel alignment. Other features are: remote control, adjustable feed mounting and a hydraulic motor of sufficient power for tightening roof bolts to safe torque levels accurately and consistently.

A RUST REMOVER, Aci-Gel, is a multi-acid material which removes rust to bare metal by chemical action, according to its manufacturers, Sloan Chemicals, Inc., Cleveland, Ohio. Aci-Gel brushes on, and flushes off with water, leaving a clean surface for painting. Aci-Gel, suspended in a thixotropic gelling agent, clings to vertical surfaces.

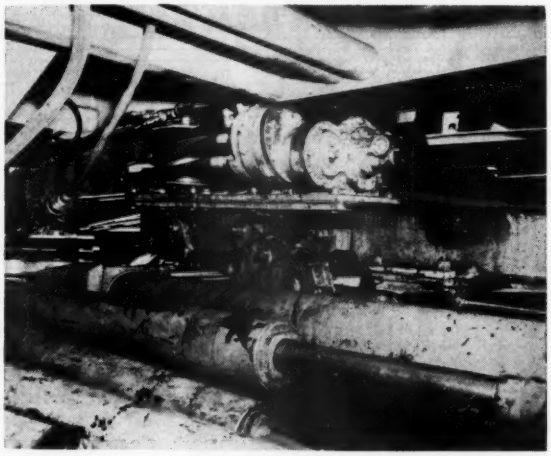
A LIMIT SWITCH featuring solid state electronics and high reliability has been introduced by the Apparatus Division of Texas Instruments Inc., P. O. Box 66027, Houston 6, Tex. The new unit, called the Statronic Limit Switch, has no make or break electrical contacts and may be used in any application where roller-level actuated switches are now employed, and requires standard 115 V a-c input power and has an operating temperature range from 0° to 200° F. It is impervious to moisture and corrosive atmospheres.

A NEW LINE OF HOSE FITTINGS AND ASSEMBLIES—"Push Ons" — developed by the Lenz Company, Dayton, Ohio, have been designed for practical, low-cost, time-saving applications in conveying air, water, oil and petroleum base fluids at pressures under 250 psi. The fittings are reusable, insert and push-on with barbed stems that lock the fitting in the hose for no pull-out. The Lenz full line of adaptors provides a multiplicity of applications. These fittings are utilized in plant maintenance, in air-operated machinery, automotive and mobile equipment, welding, lubrication and service shop equipment and many other applications. The Lenz "Push-Ons" are constructed of brass with cadmium plated steel nuts. The hose is compounded for temperature ranges of minus 40° to plus 250° F, except air which has a 160° maximum.



A FLEXIBLE, PORTABLE POWER CABLE, the Bronco 66 Certified Type SH-D, shielded 5000 volt, has been produced by Western Insulated Wire Co., Los Angeles, Calif. The outer protecting jacket has been certified to contain not less than 67.32 per cent Neoprene. Bronco 66 Type SH-D is made with a semi-conducting tape over the coated, flexible, stranded conductors to prevent the formation of corona and the resulting cutting of the insulation due to the build-up of ozone in the minute air space between the copper strands by distributing electrical stress over the entire circumference of the conductor. The cable is available with three conductors in sizes 6 through 4/0 a.w.g,. with a choice of coarse, medium, or fine stranding.

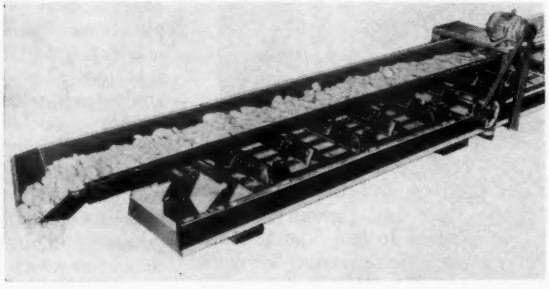
A NEW ROCK DRILL that combines the best features of rotary and percussion drilling, has been introduced by Joy Mfg. Co., Pittsburgh, Pa. Known as the Rotary Percussion Drill, or the Joy RPD, it is designed to penetrate most rock formations two to three times faster because of the combined rotary and percussion action. The drill is best suited for tunneling and underground mining operations with holes 1¼ to 1¾ in. in diameter up to 16 ft deep. Larger and deeper holes may be drilled in some formations. Rotary cutting in the Joy RPD is provided by an independent rotation system which applies high torque to the bit through a variable speed hydraulic motor and gear reduction. The drill is mounted on a heavy duty chain feed with a hydraulic motor which applies high feed pressure on the bit.



The RPD uses either water or air to flush cutting from the hole. Reduced air requirements practically eliminate "fogging" at the drilling face.

WARNING HORNS AND SYSTEMS, completely adaptable to make up, simply and at low cost, warning systems of almost any conceivable character needed for fire alarm, plant evacuation or other signaling requirements, are announced by the Falcon Alarm Co., Summit, N. J. The almost unlimited versatility of these Falcon horns and systems allows loudness and range as required, with intensely loud signals of approximately 123–128 decibels possible. Multiple horns and systems may be installed so that both controls and signals may be placed where they will be most effective and efficient. Activation may be automatic or manual, and by gas or electric impulse.

A NATURAL FREQUENCY VIBRATING CONVEYOR with a variable stroke, positive drive has been introduced by Stephens-Adamson Mfg. Co., Aurora, Ill. Inclusion of the variable stroke feature provides infinitely variable conveying speeds from zero to maximum. Speed is controlled accurately regardless of conveyor length or capacity handled, because the eccentric drive is positive and will not dampen out or lose stroke. Either remote or manual controls for the variable stroke drive are available. Adjustment of the drive can be made at any time, even during operation of the conveyor.



The new type drive is ideal for varying retention time of material in drying, cooling, de-watering, or similar operations. Another feature of the new conveyors is dynamic balancing whereby energy generated in the low amplitude vibrating coil springs is reclaimed and used to help maintain conveyor action. Stresses are uniformly distributed over the entire machine. Lubrication is confined to drive, motor, and self-aligning ball bearing units, minimizing maintenance.

A NEW TYPE OF AFTERCOOLER with matching heads and tubes, and which can be vertically stacked to match any compressor size, has been announced by Le Roi Div., Westinghouse Air Brake Co., Sidney, Ohio. Extra tubes can also be added to increase cooling capacity on all aftercoolers LeRoi manufactures in this series. Installed in the line between compressor outlet and air receiver, the aftercooler keeps compressed air cool and dry. Flow of air and water within the compressor in opposite directions assures maximum absorption of heat. Scuffed copper inserts inside the tubes provide a large radiating area for efficient water cooling.

Aftercooler tubes carry two gpm of water for optimum cooling, and cooling capacity increases as cylinders are added in a vertical stack. Each tube is 40 in. long with an overall length of 48 in. for the entire unit to conserve wall space. Aftercoolers are rated with air flows from 100 to 500 cfm at inlet temperatures from 200° to 500° and water flow from two to eight gpm.

—ANNOUNCEMENTS—

Esco Corp. has announced the appointment of **Henry T. Swigert** to the position of vice president-finance. Swigert joined the firm in 1955, and for the past two years he has been sales representative in Phoenix, Ariz.

Frank S. Pollock, a member of the board of **Atlas Chemical Industries, Inc.** for nearly 20 years and a veteran of more than half a century in the explosives industry, has resigned his position on the board. Elected a vice president in 1945, Pollock retired from active service as vice president in 1951, but continued to serve on the board. He was manager of the huge, government-owned Perryville (Md.) ammonium nitrate plant during World War I, and was the director during World War II of Atlas' government ordnance works department, which operated three government-owned ordnance plants.

The Chicago Pneumatic Tool Co. recently appointed **Russell B. Miller** general sales manager of the company, with headquarters at the New York general offices. In his new capacity, Miller, a veteran of more than 25 years with the company, will be responsible for coordinating the sales efforts behind Chicago Pneumatic's diversified products.

Frank A Seeton has been appointed manager of the Metallurgical Operations Division, **Denver Equipment Co.** Seeton was formerly field engineer, and assistant director of the Denver Ore Testing Division from 1947 to 1956. His division will coordinate and direct the Denver Ore Testing Division and the Field Service Operations.

A. D. Bullock has been named service manager for **Kenworth Motor Truck Co.**—a new position which places him in charge of the field service, service and new truck test departments. Bullock has been with the firm since 1934, serving for the past 15 years as assistant manager of the field service department.

Two major promotions on the engineering staff of **Marion Power Shovel Co.** were announced recently. **Jack F. Weis** is now chief engineer of the firm's intermediate and large machine division while

J. F. Weis

M. F. Cole

Marion F. Cole has been named chief engineer of Marion's small machine division. Weis has been associated with the company since 1929, Cole since 1927. Both men have held various engineering positions with Marion in the past.

Donald W. Waack has been appointed manager of sales promotion at **Bucyrus-Erie Co.,** South Milwaukee, Wis. He had been assistant sales development manager for Schield Bantam Co., Waverly, Iowa, and was associated with the Iowa firm for eight years.

Mine and Smelter Supply Co., Denver, has opened a new branch office in San Jose, Calif., to serve the Pacific coast area, with **Roy C. Engstrom** to serve as head of the new office. Engstrom has worked out of the company's Denver office as a metallurgical sales engineer for five years.

Dean E. McCrory has been appointed assistant district sales manager at Tacoma, Wash., for **Pennsalt Chemicals Corp.,** replacing **Ralph C. Schaeffer** who was earlier named district sales manager at Salt Lake City.

CATALOGS & BULLETINS

FIRST AID AND CONTEST EQUIPMENT. *Mine Safety Appliances Company, 201 North Braddock Ave., Pittsburgh 8, Pa.* Specially designed for training and contest work, a 58-piece first aid outfit is described and illustrated in Bulletin No. 0408-23. The outfit, containing all equipment recommended by the U. S. Bureau of Mines for first aid training, contest and emergency use, is packaged in a 92 by 14 by 13-in. steel case.

WOUND ROTOR MOTORS. *Dept. P, Louis Allis Co., 427 E. Stewart St., Milwaukee, Wis.* The company recently announced the release of Bulletin #104 on Wound Rotor Motors. Ranging in size from 1–30 hp, the new motor is designed to meet the requirements of any wound rotor application including elevators, cranes or hoists. These motors are furnished in open-drip-proof or totally enclosed, non-ventilated enclosures for horizontal, ceiling or side wall mounting.

VIBRATING SCREENS. *Syntron Company, 703 Lexington Ave., Homer City, Pa.* Bulletin No. VS-61561 gives complete descriptions, data and specifications, and more than 50 illustrations. Rotary Vibrator Screens, Grizzly Bar Screens, Screening Feeders, Mechanical Conveyors Screens and Pulsating Magnet Screens are described in detail.

ROTARY VALVES. *The DAY Company, 810 Third Ave. NE, Minneapolis 13, Minn.* Precision built Rotary Valves for feeding dry bulk materials, or for use as an air seal, are described in bulletin N-261. It details construction features of Day Type "A" and Type "B" valves, and includes application photographs, specifications, dimension charts and diagrams.

HELICAL GEAR DRIVES. *Foote Bros. Gear and Machine Corp., 4545 South Western Blvd., Chicago, Ill.* A new engineering catalog covers the company's line of heavy duty enclosed helical gear drives, and incorporates increased capacities and ratings for the entire line of Foote Bros. Helical Gear Drives. The catalog features a new and simplified selection procedure plus a complete description of various drive accessories and their application.

CLOSE-COUPLED PUMPS. *Allis-Chalmers, Milwaukee 1, Wis.* Allis-Chalmers compact close-coupled suction pump (Model C-15—Type RHK) designed for low-cost handling of clear non-corrosive liquids at temperatures up to 180° F is described in leaflet 52B1010. Available in a range through 48 gpm with heads to 100 ft, the new pump can be installed horizontally or vertically. Casings have centerline discharge, are self-venting and can be rotated to any of four 90° positions.

TRACTOR-SCRAPER. *Advertising Division, Caterpillar Tractor Co., Peoria, Illinois.* Booklet D116 describes the 619C, one of the newer machines in the Caterpillar wheel-scraper line. Loading characteristics are detailed from the time the load is picked up until it is dumped on the fill. Features described include the torque divider drive, the 18-yd bowl, and the 6-speeds requiring only 3 shifts.

FROTH FLOTATION CELLS. *Heyl & Patterson, Inc., 55 Fort Pitt Blvd., Pittsburgh 22, Pa.* Brochure 861 describes the new H & P Cyclo-Cell for Froth Flotation. Its outstanding feature is said to be the unequaled simplicity of design achieved by eliminating all moving parts. Introduced only recently into several leading coal and non-metallic mineral preparation plants, the

(Continued on next page)

(continued from previous page)

H & P Cyclo-Cell gives dependable, low-cost operation and outstanding performance with exceptionally high recovery rate. Typical flow-sheets and actual performance data of the H & P Cyclo-Cell are included in the brochure.

THICKENERS. *Dorr-Oliver Inc., Stamford, Conn.* Bulletin No. 3002 describes the complete line of Dorr-Oliver Thickeners for chemical, metallurgical and industrial processing, and describes and lists standard sizes and specifications for modern thickener designs and mechanisms. Single and multiple compartment thickeners, having both center-drive and perimeter-drive rakes in a variety of configurations for unit operations in all the process industries, are described.

MAGNETIC SEPARATOR. *Dings Magnetic Separator Co., 4740 W. Electric Ave., Milwaukee 46, Wis.* Bulletin 1206B-N describes the Dings Self-Cleaning Perma-Plate fully automatic tramp iron separator which is available in three types for suspending over conveyors, chutes or spouts. The literature describes how the unit separates tramp iron from the burden by magnetic attraction—without manual attention for cleaning.

CENTRIFUGAL PUMPS. *Goulds Pumps, Inc., 227 Black Brook Road, Seneca Falls, N. Y.* The addition of two new sizes more than double the capacity range of Goulds Model 3305–06 two-stage centrifugal pump line. Now available in sizes 6 × 8–17 and 8 × 10–17 these new units provide capacities up to 3000 gpm for heads up to 550 ft at 1750 rpm. Complete information including performance curves, material specifications, interchangeability charts and dimensions are to be found in Bulletin 722.

ROCK DRILL STEELS. *Atlas Copco, Inc., 610 Industrial Ave., Paramus, N. J. —930 Brittan Ave., San Carlos, Calif.* A new 32-page handbook, "Hand in Hand," humorously illustrates the care and handling of rock drill steels.

BACKHOE FOR WHEEL LOADERS. *Equipment Div., Young Spring & Wire Corp., Bowling Green, Ohio.* Form No. CLX-6112 describes the features of the new Ottawa LX Backhoe for Caterpillar wheel loaders, and graphically portrays the exclusive Ottawa Hydra-Hitch that allows the removal or attachment of the backhoe to the loader in only 30 seconds. The booklet also lists consrtruction features of the backhoe, gives complete specifications and provides a working range chart for digging depth, dumping height, reach and other dimensions.

ELECTROSTATIC PRECIPITATOR CONVERSION UNITS. *Buell Engineering Co., Inc., 123 William Street, New York, N. Y.* This four-page brochure, covering Buell's new silicon-rectifier conversion-unit for electrostatic precipitators, tells how silicon rectifiers reportedly provide 25 percent more efficient rectification than mechanical rectifiers, and explains how conversion unit cost, low installation cost, and virtually no maintenance costs save money for the user.

DUST COLLECTOR. *Mine Safety Appliance Co., 201 North Braddock Avenue, Pittsburgh 8, Pa.* A simple, effective collector which draws dust through hollow drill steel during placement of holes for roof bolts in underground mechanical operations is described in Bulletin No. 1207–2. The M-S-A Thru-Steel Dust Collector is approved as a unit by the U.S. Bureau of Mines, and can be legally added to any approved drill or used to convert existing systems. In operation, the collector draws dust into a slot below the bit as it penetrates the roof, routing the dust through the drill steel, chuck adapter and flexible hose by pump generated vacuum into a tank where the filter retains dust and expels clean air through a muffler to the atmosphere.

CRAWLER SHOVEL PAD. *Columbia Steel Castings Co., Inc., 933 N. W. Johnson, Portland 9, Ore.* Covering the company's Northwest Model Six Crawler Shovel Pad is bulletin number 1074, which gives comprehensive information concerning this replacement part, including metallurgical data, dimensions, weight, drawing numbers, etc.

CRAWLER TRACK PARTS. *Advertising Div., Caterpillar Tractor Co., Peoria, Ill.* Details concerning the new link for the D6, 955 and 561, and for the D7, 977 and 572 are given in Form DE109 which also notes that in the D6 series the Rockwell hardness of track links has been increased from Rc44 to Rc54. Thicker rails and struts are featured in the D7 links. There is a description of the track options for older models of the D8 and D9 in reference to the optional 9-in. pitch for the D8 or the 10¼-in. pitch for the D9.

CUTTING EDGES AND END BITS. *ESCO Corporation, 2141 N. W. 25th Avenue, Portland 10, Ore.* This twenty-four page catalog (designated 212-A) covering the ESCO cutting edges, end bits, and router bits, includes reference tables covering all major makes of graders, dozers, and scrapers, plus the ESCO cutting hardware that is available for them.

Index to Advertisers

Allis-Chalmers, Inside Front Cover
American Air Surveys, 77
American Brattice Cloth Corp., 4
American Smelting and Refining Co., 93
Anaconda Wire & Cable Co., 44
Atlas Chemical Industries, Inc., 78–79

Bethlehem Steel Co., 11, 105
Bowdil Company, 92

Card Iron Works, C. S., 109
Centrifugal & Mechanical Industries, Inc., 100
Chicago Pneumatic Tool Co., 21
  Reichdrill Division

Deister Concentrator Co., 101
DuPont de Nemours, E. I. & Co., 26

Farrell-Cheek Steel Co., 102
Fletcher & Co., J. H., 17

Gardner-Denver Co., 6
Gerow, Theron G., 77
Griphoist, Inc., 110
Gundlach Machine Co., T. J., 3
  Div. of J.M.J. Industries, Inc.

Hardinge Co., Inc., 108
Hercules Powder Co., 12
Hewitt-Robins, 24–25

Jeffrey Mfg. Co., 98

Krupp International, Inc., 34–35

Lee-Norse Co., 8–9
LeTourneau-Westinghouse Co., 22–23
Long-Airdox Co., 18–19
Longyear Co., E. J., 77, 107

Mine Safety Appliances Co., Back Cover
Moore Company, The, 104
Mott Core Drilling Co., 77

National Electric Coil Div., 106
  McGraw-Edison Co.
National Iron Co., 20
National Mine Service Co., 15
Naylor Pipe Co., 55
Nordberg Mfg. Co., 10

Ohio Brass Co., 13, Inside Back Cover

Pattin Mfg. Co., 104

Reichdrill Div., 21
  Chicago Pneumatic Tool Co.

Sheffield Division, 14
  Armco Steel Corp.
Sprague & Henwood, Inc., 46

U. S. Rubber Company, 7

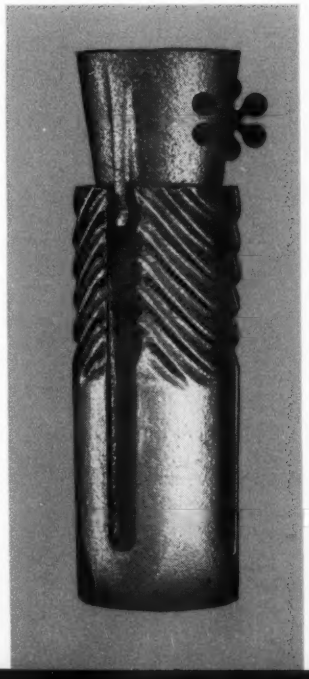
Vascoloy-Ramet Corp., 16
Victaulic Co., Of America, 5

Wild-Heerbrugg Instruments, Inc., 77
Woomer & Associates, J. W., 77

O-B Designs For Mining Men

RESULT:

A 4-way expansion unit that holds in soft shale or hard rock



4-WAY EXPANSION UNIT BUILDS HOLDING POWER FAST . . . because the flexible fingers of the shell are slightly pre-expanded to grip the wall even before wrenching begins.

GOES UP FAST AND STAYS PUT. When the bolt is shoved up the hole, the expansion unit holds the bolt in place until it's tightened . . . no need to have hands exposed to injury during wrenching.

GREATER STRENGTH IN HARD TOP . . . BETTER "PURCHASE" IN YIELDING TOP . . . because the expansion pressures are spread evenly over the four shell fingers to make the best use of the entire unit's strength. These are the reasons for the O-B Expansion Unit's popularity with mining men. It is easy to understand why more mine roof is supported with O-B Shells and Plugs than with any other kind.

For further information and prices, see your local O-B sales-engineer or write us now. OHIO BRASS COMPANY, MANSFIELD, OHIO. Canadian Ohio Brass Company, Ltd., Niagara Falls, Ontario.

Ohio Brass

HOLAN

EXPANSION SHELLS AND PLUGS • LINE MATERIALS • SAFETY AND CONTROL EQUIPMENT • ELECTRIC HAULAGE MATERIALS

THIS IS MSA: Illumination • Electronic Communication and Control • Rock Dusting and Dust Collecting • Fire Fighting Equipment • Respiratory Protection • Artificial Respiration Equipment • Personal Protective Wear • First Aid Equipment • Permanent and Portable Instruments

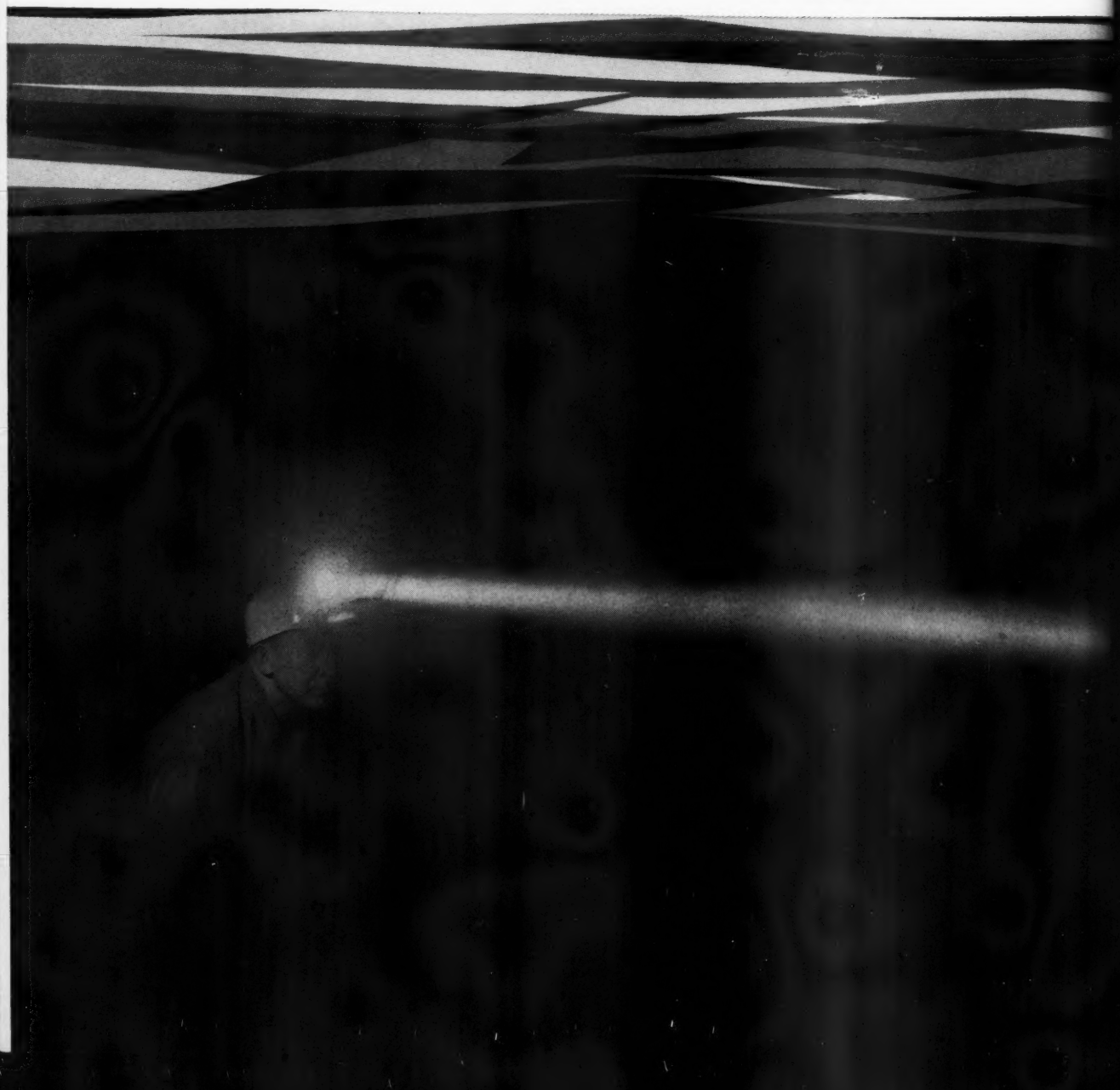
Coal comes quicker with increased working light

Now Edison Model S Electric Cap Lamps give you *more* working light than any other cap lamp.

They're throwing *more* light on the subject of man-hour productivity, too. This is the safe lamp for the miner . . . the dependable lamp for you.

Miners themselves come up with the best reasons why: 15% increase in working light . . . small lightweight headpiece . . . 400 hours bulb life in each filament . . . longer battery life . . . clear, sharp spot every time . . . and so it goes.

As for charging: no new charging racks required . . . takes either constant current or constant voltage . . . over-charging or under-charging won't affect battery life . . . never a labor-scheduling problem.

Such an increase in working light can cast a favorable image on your operating sheet. Ask your MSA Representative about it. Mine Safety Appliances Company, Pittsburgh 8, Pennsylvania. In Canada: Mine Safety Appliances Company of Canada, Ltd., 500 MacPherson Avenue, Toronto 4, Ontario.

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